

The Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II

Issued June 28th, 1920.

No. 8.

CONTENTS.

	PAGE
The Oil Palm in the East II.	265
A Host Index of Fungi of the Malay Peninsula II.	276
Castor Oil as a Crop	282
Betel.	294
Some Trials of Food Plants in the Economic Gardens III	300
Miscellaneous Notes:—Staking Yams. p. 301: Some Factors in Plant Competition. p. 302: Effect of Lighting on Trees. p. 303: Castor Oil Plant Diseases. p. 304: Manuring of Rice. p. 304: Vegetable Oil and Palm Products Industry. p. 304: Fruit Cultivation. p. 305: Cola nitida at Singapore. p. 306: Botanic Gardens. p. 306: Chrysil Rubber. p. 307: Vitamines. p. 308: The Discovery of Rubber. p. 309: How to destroy large Jungle Trees. p. 310.	

To be purchased at the Botanic Gardens, Singapore and from the Federal Rubber Stamp Coy. at Kuala Lumpur, Ipoh, and Penang.

THE
GARDENS' BULLETIN,
STRAITS SETTLEMENTS.

Vol. II.

Issued June 28th, 1920.

No. 8.

The Oil Palm in the East. II.

In the paper which appeared under the above title in the April number of the Gardens' Bulletin, several points of interest to the prospective planter of the oil-palm were touched upon, which it is now proposed to treat more fully.

Selection of Land. Most of the thick palm-forest of West Equatorial Africa is found in broad open valleys with gentle undulations, where the soil and the rainfall favour the palm, and along the level plains from the coast to the high bush. It becomes scarcer in hilly regions and it is seldom seen, except in widely scattered patches, at altitudes of more than one thousand feet. The palm-forest stops where the evergreen equatorial forest begins. *Elaeis* is essentially a tree of the lowlands and it is even found in situations which are intermittently submerged in periods of floods—but yet it does not thrive in swampy or badly drained places where water stagnates. Briefly it is at its best on well drained flats of deep rich soil with plenty of atmospheric and soil moisture, and it will be apparent, if we keep in view the general configuration of the Malay Peninsula, that its range of profitable cultivation is not a very wide one—at least not if we compare it with that of Rubber which accommodates itself to a wide range of soil conditions and to greatly varying altitudes—or with that of the Coconut which thrives right down to the sea-board in almost pure sand, or along the course of tidal rivers in salt-impregnated soil.

The selection of land for the planting of *Elaeis* will therefore have to be carefully thought out, the planter keeping well in view not only the suitability of the soil, but the configuration of the land and its easy accessibility by water or by road; also the necessity of a thorough but economic network of communications between all parts of the estate and the factory. Some of the sugar estates of Province Wellesley, long since transformed into rubber estates, with their canalisations, would probably well fulfill, in respect of communications, both internal and external, the requirements of an *Elaeis* estate; this, of course, apart from considerations of soil.

However, one thing is now certain, viz: that the *Elaeis* does grow well under congenial conditions in Malaya, and that it produces crops as heavy as those recorded from West Africa; and, although there is no room in Malaya for the vast stretches of Palm-forests as seen in Africa, it is quite possible that fairly large tracts of land could be found, suitable for its cultivation. One expert who knows the Congo well, and who is also well acquainted with Malaya is emphatic in his opinion that certain parts of the Peninsula offer ideal conditions, in point of soil and climate, for *Elaeis*.

Nurseries. Once a suitable location is found for an estate, the initial work of opening up will not present any special difficulty to a practical planter; it entails the usual programme of felling, clearing, draining, road tracing, &c., &c., but when we come to the establishment of nurseries, the difficult problem of an adequate supply of seeds will have to be faced. Seeds could perhaps be obtained from Sumatra, East Coast, where, according to the latest information, 6,500 acres, planted with 290,000 *Elaeis*-palms were in full bearing on the 30th June, 1919, producing 700,000 kilos of oil during the first half-year of 1919. If *Elaeis* has proved the success which these pioneers hoped for, they may not be too eager to part with their seeds, except at very high prices. Failing such a source of supply, seeds would have to be procured from West Africa—a proceeding not without risks, in view of the diversity of races of *Elaeis*, and their varying oil-yielding qualities. Still, the thing has been done before, with success in the case of these Atjeh plantations, and it could, no doubt, be done again.

It may be said, if all has gone well with the selection of the land, and if the difficulty of the seed-supply has been overcome, that the planter has four years of easy time ahead of him in which to lay out his estate to the best advantage. He can safely leave his seedlings in the nurseries for full twelve months, before transplanting. The writer has had occasion to transplant trees at least two and a half years old, most of which, after three months, had resumed their normal rate of growth.

Catch Crops. Here then is an opening for the planter to put down catch crops of food stuffs such as maize, sweet potatoes, groundnut, to the extent of his labour facilities, or for putting down a subsidiary crop of coffee or perhaps of cocoa, which is said to succeed particularly well in West Africa with the oil-palm, owing to the large amount of moisture which is stored in the latter's root-pad, and in the felt coating round its trunk, and which comes in as a reserve in times of drought.

Moreover, it may be observed here that the *Elaeis* does not form the same far-spreading matted rooting which characterises the coconut and renders it so uncongenial a neighbour to other plants.

At the base of the *Elaeis* a pad of earth and roots forms, from which emerge successive generations of roots most of which do not live long, but their dead remains subsist and go to swell the

pad on which the tree stands. Those roots which live radiate in all directions to a distance from the tree. The writer has followed one, by digging with a fork, to a length of 32 feet from the base of the tree. Of a uniform thickness throughout of about one quarter of an inch, they run in an almost straight line through the earth, forming very few branches (only one short branch was observed in this case) and no hair-roots; but, at every three or four inches, single short feeders, from three to eight inches long, are seen emerging from the main-root and perpendicular to it; it requires a fairly strong pull to wrench these feeders out of the earth, and, in their *ensemble*, they must constitute a very powerful anchorage for the tree. The older portion of the main-roots, *i.e.* that portion nearest the tree, is woody and somewhat brittle, but it becomes soft and pliable in the newer parts; and under the brown epidermis which rubs off easily, it is found to be quite white and turgid. If the covering tube is slit longitudinally, continuous semi-transparent cord can be detached of the appearance and thickness of Chinese vermicelli: if squeezed, water oozes out of it. This shows that, given a free open soil with plenty of moisture in it, (which is the case for the tree under review) the *Elaeïs* can draw sustenance from a fairly wide area, and, under similar circumstances, wide-planting would be indicated. But, on the other hand, these main-roots are not numerous and they are easily interpenetrated by the roots of other trees, as was found in the present case, where two neighbouring trees, (one rubber, one coffee) were found sending their roots in all directions, above and below those of the *Elaeïs*. In another case, that of an *Elaeïs* over thirty feet high, growing in stiffish laterite soil, a root one inch thick, of a *champadak* tree (*Artocarpus polyphemia*), standing 20 feet away, was unearthed within five feet of the basal pad of the *Elaeïs*. Briefly, then, the root-system of the *Elaeïs* does not form a thick network, as the coconut does, and its interference with the neighbouring vegetation does not appear to be such as to inhibit the cultivation of plants foreign to it. Hence the interplanting of a subsidiary crop, (given proper spacing), which cannot be recommended, except at quite an early stage in the case of coconut, appears to the writer's mind, as a sensible and practicable proposition in the case of *Elaeïs*. The more so as during the period of waiting for the appearance of ripe bunches of fruit, the labour of upkeep will be reduced to keeping the weeds down (work which will be assisted by the subsidiary planting), to pruning off the lower leaves, and keeping the trunks clean. Moreover, as the *Elaeïs* grow older, their productiveness will decrease, whilst, the trees being taller, fruit bunches will cost more to collect. A subsidiary crop of coffee or cocoa may then prove a saving stand-by.

The Crop. In or about the sixth year, or earlier, under favourable conditions, the first bunches of fruit may be expected and the serious work of the estate will then begin. Not that the harvesting will offer any great difficulties up to the ninth or tenth year, for the upward growth of the trees is slow up to that period, and if the

pruning of the leaves below the bunches has been attended to, the bunches will be easily accessible without climbing in most cases. But meanwhile two problems will have to be solved:

1. The transportation of the bunches to the mill, and, unless a clear grasp of the difficulties of the case has been taken at the inception of the estate, and its distribution planned accordingly, the labour involved will bear heavily on the concern.

2. The treatment of the fruit for extraction of the oil at the mill.

Touching the subject of oil-extracting machinery, the writer has already declared himself incompetent to pass an opinion on the relative merits of the appliances in use for treating the fruits of *Elaeis* and what is written below must be taken only as the result of reflexions of a layman face to face with the elemental side of the problem as it presented itself in his own homely methods of extraction as previously described (Bulletin April 12th).

At the end of the latter Bulletin the writer expressed the view that the future of *Elaeis* is bound up with, among other conditions:

"A judicious use of native methods of "depericarping" blended "with mechanical devices of well-authenticated efficiency."

An article of The Tropical Agriculturist of March 1920, affords an opportunity of amplifying that statement. The article is an extract of the Bulletin of the Imperial Institute, Vol. XVII, No. 2, which, itself, is a reproduction of a report of Mr. A. Bories, Inspector of Agriculture, French Equatorial Africa, published in the "*Bulletin des Matières Grasses*," No. 2, 1919. The gist of the report is given below, but as in the conversion of French weights into English, certain minor errors have crept into the account. Mr. Bories' figures are here reintroduced.

On a "palmery" at Louna (Gabon) consisting of 30,000 palms which had been looked after and kept clean during a previous period of three years, 4 men and 4 women were told off to gather a crop of *Elaeis* and bring it to its ultimate result, viz: clean oil.

The first day was spent in collecting and transporting the bunches to the house. The result was 120 bunches weighing each about 10 kilos = 1200 kilos = 2640 lbs. equivalent to 1700 pounds of fruit. The bunches being of full ripeness the picking of the fruit out of the bunches was easily performed in the course of the afternoon.

The second day was spent in making the oil, an operation which took altogether about five hours, consisting in 1st cooking the fruit, 1 hour 30 minutes; 2nd pounding, 30 minutes; 3rd depulping, sorting out the stones and re-heating the pulp, 1 hour 30 minutes; 4th extraction of the oil, 1 hour.

Cooking the fruit was done successively in three iron pans, each of a capacity of 22 gallons, each receiving about 190 pounds of fruit, with about 4 gallons of water. The whole was covered with banana leaves. When, after $1\frac{1}{2}$ hours cooking over a brisk fire the fruits were sufficiently softened, they were shovelled into a mortar.

Pounding the fruit and sorting out the stones. The usual form of wooden pestle was used. The pounded mass is then laid on iron plates where the women do the picking out of the stones, the fibrous pulp being put in wooden buckets, which were in this case barrels sawn in two.

Re-heating the pulp. The pulp now cooled is re-heated by means of stones heated to a very high temperature, which are dropped and stirred in the mass of pulp.

Extraction of the oil. The pulp is ladled into sacks made of rotan with a slit on their sides by which the pulp is introduced. At both ends of the sacks are loops through which a pole is passed and by turning these in opposite directions, the torsion produced on the sacks forces the oil out.

The next day the oil is boiled over a slow fire, which causes the water to evaporate, while the scum formed on the surface by impurities is skimmed off.

The yield of oil was equivalent to 12% of the weight of fruit, to which should be added the yield in Kernels (omitted in Mr. Bories' report) say at the rate of 20% of the weight of the fruit.

Thus we get as the output of two days' work of 4 men and 4 women,

1700 lbs. of fruit =	204 lbs. of palm oil.	..
plus	340 lbs. of kernels.	

This put into Malayan figures at a price of (see Bulletin des Planteurs de Caoutchouc December 1919).

Florin 0.40 per kilo of oil in Sumatra.
0.20 „ of kernels do.

is equivalent to f 0.18 and f 0.09 per pound and we obtain as final result,

204 lbs. of oil @ 0.18 =	f 36.72
340 „ kernels 0.09 =	30.60

f 67.32 = @ 1.15 = \$58.50

Straits Currency.

Thus 16 days (8 people for two days) of coolie labour have produced a value of \$58.50, or one coolie day, costing, say one dollar, has brought in \$2.65 of nett revenue, less cost of cultivation.

This figure would do credit to a crack rubber estate; the more so as we are dealing with a process which, although constituting a great progress on the old native method of fermenting the fruit in heaps, is still very crude and capable of great improvement, (with consequent increased yield of oil), without the aid of any very complicated machinery.

But can we accept the above account of work as representing a normal and regular daily output of a coolie-day?

Here we have a very high official inspecting a crack palm-stand of 30,000 trees, kept up to the topmost state of cultivation obtain-

able in the country. It is highly probable that the manager in charge will choose for trees to operate upon, those which bear the heaviest crop of well-ripened bunches and will, besides, put in charge of the work, his most proficient labourers. The manager of a crack rubber estate, placed in similar circumstances, would, in all probability, select a first-rate tapper to tap a few chosen trees among his best "milkers" leaving aside those that have run dry through Brown Bast or other disease. Thus, in all good faith, startling results could be shown, but they would not be, in any way, representative of the normal yield of all the trees on the Estate.

Be this as it may, the process described above deserves to fix our attention for other reasons. Crude as it is, there is found in it a train of thought which inclines one to think that it was not born in the brain of the natives of West Africa without suggestion from the white man.

The most convenient way of separating the pulp from the stones, that which offers the line of least resistance to the native, is the fermentation process, which, if carried on long enough, causes thorough disintegration but causes also a considerable increase in the degree of acidity, which in oils so obtained, often amounts to 25 and even 30%, whereas the oils obtained by the above method are said to contain no more than 10 to 12% of free fatty acids. By carrying the process right through without interruption from the gathering of the bunch to the expression of the oil—by submitting the fruit at once to a steaming process in a small quantity of water, these natives suppress, or greatly check the formation of ferments—in fact their process is akin to a veritable sterilisation.

The same aim is furthered by using hot stones instead of water to increase the fluidity of the oil in the pulp, besides which the after operation of expelling, by evaporation, a great mass of water is dispensed with.

We can therefore trace, in the process, a set purpose of checking fermentation, which was probably initiated by Europeans in the beginning.

But, although the extracting process may be considered as satisfactory, so far as it goes, from the point of view of the degree of acidity, there is yet ample room for improvement in the man handling of the crop, by, as previously suggested, "a judicious blending of native methods with mechanical devices."

It may not be possible to attain the rapidity of action of the Trevor system, which, it is claimed by the inventor, can extract the oil within thirty minutes of the arrival of the fruit at the factory, but yet much time might be saved on the sequel of operations previously described.

For instance, it took 8 people one half-hour, *i.e.* 4 hours to pound the fruit in mortars, an operation which a hand-contrivance

in the nature of a disc coffee-pulper with a revolving rasping surface, could probably effect in much less time, and with less labour as the material would be worked by gravitation through hoppers.

Again, coils of heated steam in autoclave pans would advantageously take the place of hot stones to heat the pulp and would do it in half the time.

Lastly, a handscrew-press or a hydraulic press would be a sure improvement on the twisting of the rotan-bag.

It is therefore quite possible, even while following the lines of native methods, to reckon on an increased production of oil which would bring the output to a figure not very far behind the 16% which is the actual percentage claimed for modern mechanical appliances.

Conclusion. A question was hinted at, towards the end of our previous paper which was put to the writer, somewhat in the following way:

“Given the existence in West Africa of large stands of *Elaeis*, growing in its own native habitat and largely in the bearing stage—exploitable at once at the cost of clearing the undergrowth and cleaning the trees—would not capitalists, following the lines of least resistance, be more readily attracted to such a proposition than to one entailing the heavy toil and expense, and the long wait for results, implied by the opening up of jungle land, in a country like Malaya, which has the further disadvantage of greater distances from the home markets?”

The situation here presented, has, to some extent, a parallel in the “*Estradas*” of *Hevea* in its natural habitat on the Amazon, where the “*Seringuero*” collects the latex and coagulates it on the spot. We know, however, that this method of production cannot hold its own, either in the matter of economy or of quality and purity, against the product of cultivated rubber.

But would not the case be materially altered, if, instead of isolated trees or colonies of trees widely scattered in the forest, the *Hevea* trees were found in pure, unmixed stands over extensive tracts of forest, necessitating only the erection of a factory on the spot to transform the latex into clean, pure sheet, or crêpe rubber? In a word, viewing the *Elaeis* as it presents itself in many parts of West Africa, in large pure stands of forest, is it not conceivably possible that it would be readily exploitable in an economic way by a factory on the spot?

Not knowing the country, the present writer is unable to view the question in all its bearings, yet certain points force themselves on the mind which tend to show that the process may not be so simple nor so inexpensive as appears at first sight.

To begin with, these extensive stands of *Elaeis*, or the right to exploit them, belong, presumably, to somebody, to neighbouring villages or communities or to their chiefs, from whom they would

have to be acquired, and, in that case, we should soon see the "option" hunter appear on the scene and it is not usual with him to give anything for nothing.

In the second place, these stands, or "*Palmeries*," (shall we call them?) would have to fulfill certain essential conditions, which are so varied that it seems impossible that they should be met in their entirety, in a state of nature.

A suitable spot must be found for the factory with abundance of water near by. The factory must be accessible by light railways or by canals (cattle draught cannot be used in West-Africa owing to the tse-tse-fly) to all parts of the estate, as the carriage of the bunches to the factory is inconceivable in any other way.

These railways or canals, to serve their purpose effectually, cannot be made to twist their way round about irregular lines of trees; they must be laid symmetrically and at short intervals, between well defined rows of trees—which can only exist on an estate conceived and developed on a systematic plan.

If, on the other hand, as was the case presented in our first paper in the Gardens' Bulletin for April, it is proposed to erect a plant to treat 9 tons of fruit daily, we shall have to acquire a far larger tract of "*palmeries*" than the 1200 acres which the scheme implies, for it is not possible to suppose that these natural stands, partly planted, and largely propagated from fallen seeds, will be, all over, in the same stage of growth. Some parts may be too young, some too old to pay for collection, others, growing in less favoured spots, will yield smaller bunches. The stand, in a word, will not offer that uniformity and stability of production which one can reckon with on a systematically planted estate. Hence, if the daily supply of 9 tons of fruit is to be kept up, and the factory is to be kept working full time, the cropping area will have to be largely in excess of the 1200 acres assumed to be sufficient to feed the factory. Hence, also, increase of means of communication, increase of railway mileage, of wagonets, and lastly increase of labour—labour, the stumbling-block of the cultivation of the oil-palm in West Africa and perhaps elsewhere. Further, if we suppose that the owner of the oil-factory relies for his supplies of fruit on deliveries from the neighbouring villages, by purchase of the fruit instead of employing his own labour, it is fairly certain that, contract or no contract, his supplies will be, to say the least, erratic; and it is well to note here, that under penalty of increasing the free-acid content of the oil the fruit must be treated fresh.

Another aspect of the question here presents itself. So far, very little of the oil exported from W. Africa is extracted mechanically; the whole of it, practically, is made by the natives themselves by their own methods it is a familiar industry in which women and children contribute their quota. But when it comes to mechanical treatment of the fresh fruit at the mill, the whole character of the industry is altered. The work is mainly plain coolie work, confined to climbing up the palms after the fashion



A Native of Congo climbing
up an *Elaeis*.

After a photograph taken in the
Lusango District (Congo).

shown in the accompanying woodcut; to chopping off the bunches, and carrying them whole to the factory. That is to say carrying also a mass of useless matter, 100 kilos of bunches containing only from 50 to 60 kilos of fruit, equivalent to a quantity of (16%) 8 to 9 kilos of oil and 12 kilos of kernels.

That the work is irksome, we have shown, that the climbers dislike it, is a known fact. We are therefore not surprised to read that climbers are getting more scarce every year, and that the gaps thus made in the available labour of the country cannot be filled by imported

labour, for they cannot climb.

Turn which way we like, we find these two initial difficulties confronting us, viz: the climbing, and the collecting of the nuts, not to mention their transportation to the factory—and that in a greatly aggravated degree, in the case of the exploitation of the West African "*Palmeries*" owing to the uncared-for state of the trees—to their disparity of growth and the absence of ways of communication with the factory. So great are these difficulties that writing from Porto-Novo in 1919, a correspondent of the *Bulletin des Matières Grasses* No. 5, gives it as his opinion that only trees which can conveniently be reached with a ladder should be kept standing, all older trees which require climbing being cut down.

It would be an idle waste of the reader's time to labour further this question of "Wild versus Cultivated *Elaeis*" and we should have left it untouched, had it not been put to us with some insistence.

The following words taken from the *Bulletin des Matières Grasses* No. 4 throw more light on the subject than we could ever hope to do.

"For a long time, the possibility of the successful establishment of an industrial exploitation (of the oil-palm) in West Africa has simply been denied. Even now, the majority of the heads of the great Commercial Firms, and of their Agents are convinced that any undertaking of that description is doomed to assured failure, for the reason that the times have not yet come when it will be possible to find the necessary labour among the native population."

And the commentator, himself an advocate of industrial exploitation clinches the matter with the following remark:

"The success of the mills erected in Senegal for the decortication of arachides (ground nut) demonstrates how erroneous that opinion is."

Seeing, that, of all oil-seeds, ground nut is about the easiest to cultivate, to transport and to decorticate—all things which the *Elaeis* is not—this argument fails to convince.

The present paper was ready for the press when the writer received the "*Bulletin des Matières Grasses* 1919, No. 6" with Mr. van Pelt's report of his mission of investigation in West Africa, which deals most fully with the question of the industrial exploitation of the Palm-forest as it stands. He sees no possible future in it and the reasons he gives are so cogent that they are unanswerable.

According to Mr. van Pelt, a careful valuation will show that, taking a block of palm-forest, not more than 25 trees to the hectare are immediately exploitable: that their output may be computed at 5 bunches weighing 10 kilos each, and yielding altogether 25 kilos of fruit per year *i.e.* for 25 trees, 625 kilos.

Here then, we have from the pen of a highly competent and unprejudiced observer an estimate of the capabilities of a palm-stand in its natural state given as 550 pounds of fruit to the acre per year, which, treated at the oil-mill, will give at the rate of (16 to 20%) say 18%—100 pounds of oil of a value (£80 per ton in London) of 71 shillings!

If we carry these figures to their logical end, we reach terms of pure impossibilities. For instance, to obtain 2700 tons of fruit, we shall require not 1200 acres which we found in our previous paper (April Bulletin) were necessary to keep a mill supplied with fruit for 300 working days at 9 tons per day; we shall require 11,000 acres, each acre containing 10 trees with 5 bunches that is to say 110,000 trees and 550,000 bunches. If, as Mr. van Pelt does, we estimate the capacity of a climber at 20 bunches a day *i.e.* 6,000 bunches a year, we shall require 100 climbers to do nothing else but chopping off the bunches apart from the collecting and transporting to the mill, which in itself, will require a very large number of hands.

As will be seen from the above digression Mr. van Pelt's cogent remarks completely confirm the present writer's views of the impossibility of an economic exploitation of the *natural* stands of oil-palms. If *Elaeis* is destined to find a home in Malaya, as a cultivated product, it will have nothing to fear from its wild congener of West Africa—it will rather be the other way round, as the past history of Rubber shows.

Before finally closing these notes, the writer would call the attention of his readers to an interesting group of photographs of *Elaeis* grown in Sumatra, given by the Bulletin de l'Association des Planteur de Caoutchouc of February 1920. One tree, 4 years old showing a number of large bunches, hanging about 3 feet above ground, offers an object-lesson to the future planter of *Elaeis*: the

branches below the bunches having been cut, the bunches instead of being compressed between the trunk and the leaves, hang outwardly, which allows them to expand and to receive on all sides the action of the sun, insuring thereby uniform ripening of the fruit—one of the problems of the cultivation of *Elaeïs*.

A remark in the previous paper, *Gardens' Bulletin* Vol. II, No. 7, p. 222 needs amending. An acre is put down as containing 50 trees planted 27 feet by 27 feet. *Elaeïs* should in no case be planted less than 30' x 30' which would give 48 trees to the acre. Its spread of leaves commands that span, and closer planting would be the surest means of encouraging growth upward, in response to the call of the sun, which all close-planted trees have to obey, at the expense of the proper expansion of their trunks. Above all things to be avoided in the *Elaeïs* are a long stem and a high crown.

After the above had been written the *Bulletin des Matières Grasses* 1920 No. 1 came to hand with a very interesting notice written by Mr. Fauconnier, the well known planter of Rantau Ranzong (Selangor) with facts and figures which are of importance to the prospective planter of *Elaeïs* in Malaya.

His investigations show that: :

1. *Elaeïs* yields larger bunches in Malaya than in Africa, weights being recorded of 62 kilos.
2. The fruits of the Malayan *Elaeïs* are richer in oil, as much as 30% of Palm-oil being obtainable.
3. *Elaeïs* begins fruiting at 3 years and attains maturity at 5 years.

The yields obtained from 100 kilos of fruit bunches are 15 kilos of palm-oil, 12 to 15 kilos of kernels.

And the final conclusions are:

One acre planted with 40 trees = 6,000 kilos of bunches = 800 kilos of palm-oil plus 800 kilos palm-kernels.

Mr. Fauconnier's experience entitles these figures to our full acceptance. There only remains the question of the working costs and of the efficacy of present day machinery to obtain in practice, the output of oil as found to exist in the fruit of the Malayan *Elaeïs*.

REFERENCES:

- Bulletin des Matières Grasses* de l'Institut Colonial de Marseille, 1919, Nos. 2-16.
- Bulletin de l'Association des Planteurs de Caoutchouc*, February, 1920.
- Tropical Agriculturist*, March, 1920.

E. MATHIEU.

A Host Index of Fungi of the Malay Peninsula. II.

HEPTAPLEURUM, sp. (Araliaceae).

In the Singapore Gardens, C. F. Baker, collected *Lembosia heptapleuri*, Sacc. sp. nov. (*Hysteriaceae*) on the leaves of this plant.

HEVEA BRASILIENSIS, Muell. (*Euphorbiaceae*). Para Rubber Tree.

A list of the fungi found on this tree was published in "The Garden's Bulletin," Vol. II, No. 6.

HIBISCUS ROSA-SINENSIS, L. (*Malvaceae*).

A. Sharples found that the fungus causing the "die-back," which often affects an ornamental Hibiscus hedge after it has been pruned, is due to a species of *Fusarium* (*Tuberculariaceae*). Spraying with Bordeaux mixture after pruning is recommended as a preventative.

HIBISCUS SABDARIFFA, L. Jamaica or Red Sorrel. The Rozelle.

C. F. Baker records two fungi on the dying stems of this plant. *Dothiorella rugulosa*, Sacc. sp. nov. (*Sphaerioidaceae*) causing black warty excrescences to appear, and *Diplodia hibiscina*, C. and Ell. var. *subdariffae* Sacc. var. nov. (*Sphaerioidaceae*), which appears as minute black pimples.

HIBISCUS, spp.

Brooks records this as one of the many hosts on which he has found Pink Disease, *Corticium salmonicolor*.

ICHNANTHUS PALLENS, Munro. (*Gramineae*).

Recorded by Bancroft as having its inflorescence attacked by *Balansia asperata*, Massee. (*Hypocreaceae*).

Another species of the same genus was similarly attacked by *Balansia sessilis*, Massee.

IMPERATA ARUNDINACEA, Cyt. (*Gramineae*). Lalang grass.

A rust, *Uredo imperatae*, P. Magn. (*Uredinaceae*) is recorded by Bancroft as being found on this grass.

INDIGOFERA ARRECTA, Hochst. (*Leguminosae*) Otaheite Chestnut.

Three fungi are recorded by Baker on the rotting fruits of this plant in the Singapore Gardens. *Phoma inocarpi*, Sacc. sp. nov., *Diplodia inocarpi*, Sacc. sp. nov., and *Gloeosporium inocarpi* Sacc. sp. nov. (*Sphaerioidaceae*).

JUSTICIA GENDARUSSA, L. (*Acanthaceae*).

Brown discoloured areas on the leaves of this plant were found to be caused by a smut, *Ustilago Thwaitesii*, Berk. (*Ustilaginaceae*), Herb. Singapore.

KOOMPASSIA MALACCENSIS, Maing. (*Leguminosae*).

Mentioned by Bancroft as a well known jungle host of *Fomes lignosus*.

KORTHALSIA GRANDIS, Ridl. (*Palmaceae*).

Baker records *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*) as being found on dead petioles and rachises at Singapore.

LANSIUM DOMESTICUM, Jack. (*Meliaceae*). Langsat.

Recorded by Brooks amongst the hosts of Pink Disease.

LASIA HETEROPHYLLA, Schott (*Aroideae*).

Baker records *Sphaerella lasiana*, Sacc. sp. nov. as occurring on the leaves of this plant. It causes grey brown circular blisters, the fungus fructifications appearing as black specks.

LICUALA, spp. (*Palmaceae*).

Several species of fungi were found on the leaves and rachises of these palms by Baker at Singapore. *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*), *Sepedonium dubium* Sacc. sp. nov. (*Moniliaceae*), *Coniosporium vacuolatum* Sacc. sp. nov. (*Dematiaceae*), and *Cercospora virens* Sacc. sp. nov. (*Dematiaceae*), all appear as small black excrescences on the rachises. *Helminthosporium macrurum* Sacc. sp. nov. (*Dematiaceae*) appears as black dots on the leaves.

LIVISTONA COCHIN-CHINENSIS, Blume (*Palmaceae*). Serdang.

Mentioned by Bancroft as being one of the jungle hosts of *Fomes lignosus*. *Melanconium melanoxanthum* B. and Br. (*Melanconiaceae*) and *Winterina Bakeriana*, Sacc. sp. nov. (*Sphaeriaceae*) are recorded by Baker from Singapore as being found on the dead leaves and rachises.

LYCOPERSICUM ESCULENTUM, Mill. (*Solanaceae*). The Tomato.

In Bancroft's list of diseases published in 1911 he mentions as having found two fungi on locally grown tomato plants. *Bacillus solanacearum* (*Bacteriaceae*) which causes a wilting of the plants and a brown colouring of the stem occurs so badly in some parts as to render the successful growing of these plants almost impossible. A mildew, *Erysiphe Polygoni*, D. C. (*Erysiphaceae*) was also found on plants growing at Taiping.

MACARANGA GRIFITHIANA, Muell.-Arg. (*Euphorbiaceae*).

Ridley records a specimen of this tree which had been used for bridging as bearing *Eutypa caulivora*, Mass. (*Sphaeriaceae*). He considered it had attacked the plant after it had been cut down. It appears as black asphalt-like fructifications on the stem.

MALLOTUS sp. (*Euphorbiaceae*).

Specimens in the Singapore herbarium show leaves of this plant as being attacked by a species of *Sphaerella* (*Sphaeriaceae*) and *Pestalozzia* (*Melanconiaceae*). Both fungi cause light brown circular spots on the leaves.

MANGIFERA INDICA, Linn. (*Anacardiaceae*). Mango.

Only three fungi have so far been definitely recorded on locally grown trees for this species. *Gloeosporium mangiferae* Noack, (*Melanconiceae*) which Bancroft describes as developing black spots on the fruit. These spots increase in size and run together until sometimes the whole surface is affected, the pulp becoming soft. Baker found two leaf fungi, one the common black leaf mildew, *Meliola mangiferae*, Earle, (*Perisporiaceae*) the other *Zimmermanniella trispora*, P. Henn. (*Dothideaceae*), occurring as raised black knobs on the leaves.

MANIHOT UTILISSIMA, Pohl. (*Euphorbiaceae*). Tapioca. Cassava.

Bancroft records *Cercospora Cearae*, Petch, (*Dematiaceae*) as causing leaf spots on this plant, and also a curious occurrence of *Fomes lignosus* on the tuberous roots, this latter fungus being admittedly a wood destroyer.

MUSA, sp. (*Scitamineae*). Banana.

The fact that only one fungus has been definitely recorded for this plant in Malaya, is without doubt, only due to the fact that it has so far not received much attention locally. *Gloeosporium musarum* Cke. and Massee (*Melanconiaceae*) is included in Bancroft's list, as occurring on the ripe fruits.

NEPHELIUM LAPPACEUM, Linn. (*Sapindaceae*). Rambutan.

A black mould, *Meliola nephelii*, Sacc. sp. nov. (*Perisporiaceae*) was collected on the leaves of this species by Baker, at Singapore. It is rather surprising that hitherto no other fungi have been recorded for this popular fruit.

ONCOSPERMA FILAMENTOSUM, Blume (*Palmaceae*). Nibong.

Bancroft quotes this as one of the jungle hosts of *Fomes lignosus*.

ORMOSIA SUMATRANA, (Leguminosae).

Baker collected specimens of *Lembosia hormosiana* Sacc. sp. nov. (*Hysteriaceae*) on the leaves of this plant.

ORYZA SATIVA, Linn. (*Gramineae*). Rice.

Only one fungus disease can so far be found definitely recorded for this important crop in Malaya. A smut, *Ustilago virens* Cke. (*Ustilaginaceae*) is mentioned by Bancroft as being parasitic on grains of rice in Perak.

PALAUQUUM OBLONGIFOLIUM, Burck. (*Sapotaceae*). Gutta percha. Taban.

Bancroft records *Laestadia palaquii*, Banc. (*Sphaeriaceae*) as causing a leaf spot disease of this plant, which in the seedling stage often proves fatal.

PANDANUS PENANGENSIS, Ridl. and

PANDANUS UTILIS, Bory. (*Pandanaceae*). Screw Pine.

On the leaves of both of the species Baker found *Lembosia pandani* Sheiss, (*Hysteriaceae*).

PASPALUM, sp. (*Gramineae*).

Ridley collected a specimen of this grass with its lateral branches distorted by *Hypocrella panici*, Mass. (*Hypocreaceae*).

PASPALUM, sp. (*Gramineae*).

Chaetostroma cladosporioides, Sacc. (*Tuberculariaceae*) was collected by Baker in Singapore on the dead fruits of this grass.

PINANGA, sp. (*Palmaceae*).

In a part of the Garden's Jungle at Singapore, that is being devastated by a fungus a species of *Rosellinia* (*Sphaeriaceae*) that was found on a dead stem of this palm seems chiefly responsible. The species cannot be determined at present, but is near *R. parasitica* E. and Ev.

PIPER, sp. (*Piperaceae*). Pepper.

The various species of pepper in local cultivation have not received much attention at the hands of the pathologists. Only two fungi are recorded for them. *Colleototrichum necator* Mass. (*Melanconiaceae*) was found by Ridley attacking the fruiting spikes and causing them to blacken and fall off. A species of *Diplodia* (*Sphaerioidaceae*) was at the same time observed growing on the roots.

PISCIDIA ERYTHRINA, Linn. (*Leguminosae*). Fish Poison Tree.

Baker records two fungi as growing on the dead limbs of this tree. *Dothiorella stratosa*, Sacc. (*Sphaerioidaceae*) causing black excreescences, and *Hymenula socia* Sacc. (*Tuberculariaceae*).

PLECTOCOMIA, sp. (*Palmaceae*).

Four fungi were found by Baker all appearing as black specks on the dead leaves and rachises of this Rotan.

Graphiola macrospora, Penz. and Sacc. *Melanconium melanoranthum*, B. and Br. (*Melanconiaceae*) *Arthrobotryum socium*, Sacc. (*Stilbaceae*) and *Erosporium macrurum*, Sacc. (*Tuberculariaceae*).

POLYTRIAS PRAEMORSA, Hack.

A smut, *Ustilago polytriadis* Mass (*Ustilaginaceae*) is recorded on the ovaries of this plant.

PTEROCARPUS INDICUS, Willd. (Leguminosae).

Owing to the loss of so many famous avenues of this tree in the country it has received more attention than other ornamental trees. Consequently six fungi have so far been reported as having been found growing on it, although except the leaf fungi all were collected on dead stumps. It is possible however, that some may be responsible for hastening its death, the fungus fructifications only appearing at a later stage when the damage is done, and in this connection the shiny chocolate brown bracket fungus, sometimes appearing with a false stalk, *Ganodermus lucidus* (*Polyporaceae*) is more than suspected. Other Polyporaceous bracket fungi recorded are *Polystictus hirsutus* Fr., and *Polystictus floridanus*, Sacc. The small white tomentose fan shaped *Schizophyllum commune* Fr. (*Agaricaceae*) is commonly found on dead wood but doubtless as a saprophyte only. Leaf fungi recorded are *Dothidea pterocarpi*, Mass. (*Dothideaceae*) and *Helminthosporium obovatum*, Mass. (*Dematiaceae*).

RHODOMYRTUS TOMENTOSA, Wight. (Myrtaceae). Kamunting.

Two fungi are recorded by Baker for this shrub *Dimerium singaporense* Sacc. (*Perisporiaceae*) and *Podosporium penicillium* Speg. (*Stilbaceae*).

ROSA, sp. (Rosaceae) Rose.

Only one fungus *Sphaerostilbe cinnabarina*, Tul. (*Hypocreaceae*) is recorded for our cultivated roses. It causes the branches to blacken and die.

SACCHARIUM OFFICINARUM, Linn. (Gramineae). Sugar Cane.

The fact that only one fungus is recorded for the Sugar Cane can only be attributed to the fact, that the cane had ceased to be cultivated locally as a first class crop, before the study of diseases was seriously attempted here. A red smut fungus, *Trichosphaeria sacchari* Mass. (*Sphaeriaceae*) is the only record we have.

SARACA, sp. (Leguminosae).

Microthyrium brownianum, Sacc. (*Microthyriaceae*) was collected by Baker at Singapore on the leaves of this shrub.

SELOSIA SUMATRENSIS, (Gramineae).

Singapore material in the herbarium shows the fruits of this grass to be infected with a smut *Ustilago flavo-nigrescens*, B. and C. (*Ustilaginaceae*).

SHOREA, sp. (Dipterocarpaceae), Meranti.

Bancroft's list of jungle hosts of Pink Disease includes this tree.

SOLANUM TUBEROSUM, Linn. (*Solanaceae*). Potato.

The bacterial disease *Bacillus solanacearum* was found on potato plants at Taiping by Bancroft.

STERCULIA, sp. (*Sterculiaceae*).

Dimerosporium albomarginatum, Sacc. (*Perisporiaceae*) was found by Baker on the leaves of this tree.

STROBILANTHES, sp. (*Acanthaceae*).

Recorded by Ridley as a host for Pink Disease.

TABERNAEMONTANA, sp. (*Apocynaceae*).

A brown leaf spot disease (*Cercospora tabernaemontana* Syd. (*Dematiaceae*)) is found on specimens in the Singapore herbarium from Taiping.

TEPHROSIA HOOKERIANA, Wight and Arn. (*Leguminosae*).

Sharples records a patch of this plant growing under rubber as being badly attacked by Pink Disease, and providing a centre of infection for the rubber.

THEA SINENSIS, Linn. (*Ternstroemiaceae*). Tea.

The "copper blight" *Laestadia Theae*, Rac. (*Sphaeriaceae*) is the only fungus actually on record, although instances of the blister blight *Pestalotzia* sp. (*Melanconiaceae*) are undoubtedly common.

THEOBROMA CACAO, Linn. (*Sterculiaceae*). Cocoa.

Another example of a host of Pink Disease, recorded by Brooks.

TRISTANIA GRIFITHII, Kurz. (*Myrtaceae*).

Brown circular leaf spots on the leaves of this shrub recently collected were found by Wakefield to be caused by a new species *Sphaerella Tristaniae* Wakf. (*Sphaeriaceae*).

WORMIA SUFFRUTICOSA, Griff. (*Dilleniaceae*).

A black leaf mildew *Meliola malaccensis* Sacc. sp. nov. (*Perisporiaceae*) is recorded by Baker as having been found on the leaves of this shrub.

ZALACCA EDULIS, Bl. (*Palmaceae*). Buah Salak.

Micropeltis marginata, Mont. (*Microthyriaceae*) causing brown discoloured area on the leaves, and also *Melanconium melanoranthum* B. and Br. (*Melanconiaceae*) were collected by Baker in Singapore.

ZALACCA WALLICHIANA, Mart. (*Palmaceae*). Kumbak.

Micropeltis marginata is also recorded by Baker for the leaves of this species.

ZEА MAYS, Linn. (*Gramineae*). Indian Corn.

The smut *Ustilago Maydis* (*Ustilaginaceae*) is the only record for this crop. It destroys the cobs turning them into a sooty mass.

ZINGIBER, sp. (*Scitamineae*). Ginger.

Hypocrella zinziberis, Mass. (*Hypocreaceae*) was found by Ridley on the petioles of this plant. The fungus has a bright orange coloured stroma.

The above brings to a conclusion the summary of fungus diseases of plants in Malaya as hitherto definitely recorded. The list is small and many of our best known farm and garden plants have but a small record against them. This no doubt is due to the fact that the main crops, such as rubber, have hitherto engaged the attention of the few pathologists that have worked out here. As this work increases more attention will be able to be given to other plants quite important in themselves but not ranking with the main crops of the country. When the next revision of this list takes place it is certain to be considerably increased. In the meantime additions will be published in this Bulletin from time to time as they occur.

T. F. CHIPP.

Castor Oil as A Crop.

The Castor-oil plant (*Ricinus communis*), seems so far, to have attracted little notice in Malaya, and yet, when looked into its cultivation appears to offer fairly good prospects for the small planter, while the industry of mechanical expression of the oil offers a promising opening for the establishment of up-to-date mills.

It brings prompt returns to the cultivator and its product, whether in seed, or oil, or cake is in increasing demand from home at steadily advancing prices.

According to the Chemist and Druggist 28th February, 1920, the prices quoted by the pressers in Hull were £114 per ton for pharmaceutical oil—£111 for first pressing—£109, for second pressing. For medicinal French oil, the price was 120/- per cwt. in cases.

The present price (1st May, 1920) of Castor-oil in Singapore, obligingly supplied by the Secretaries of the Chamber of Commerce is quoted at \$50 per case of 74 to 75 catties packed in 4 tins, or 0.66 per catty.

The Blue Book states that 861927 gallons of lubricating oils were imported into the Straits Settlements in 1918, the value being \$1,036,943.

We cannot apportion the amount for which Castor-oil enters in this aggregate, but we know that being a heavy-bodied oil and the most viscous of all fatty oils, it occupies a large place among lubricants for machinery, especially for the oiling of fast moving machines.

The writer has not at hand the figures relating to Medicinal Castor-oil, but here, also, we know that the figure must be a large one, and judging by the price of 85 cents, which the writer recently paid for a 10 ounce bottle of Morton's Castor-oil, we may imagine that, in passing from the seed to the bottle and finally to the consumer, the oil gathers unto itself many little rivulets of handsome profits.

The Castor-oil plant, of which there are small plots in the Economic Gardens, does extremely well in light alluvial loams, well supplied with organic matter. Sown in such soil from seed on 5th November, 1919, several trees are now, at time of writing, 1st May, 1920, showing well-formed fruiting spikes. One panicle, off one of these trees has already given 120 ripe seeds, and the rest of the seed will require picking in a very few days. These trees are from 4 to 5 feet in height.

Next to this plot is another one sown on the 10th of January, i.e. exactly 110 days old at the time of writing, of a smaller variety, whose plants are already, at a height of 3 feet, flowering heavily; one tree with five spikes in different stages of development.

In thin clayey soils and in sandy soils the growth of the plant is slow and its seed production is small. Yet, in India it is said to do well on red laterite soils at the foot of hills, provided they are not too stiff and they keep moisture well: but if they are poor in organic matter, they must receive an application of cowdung well incorporated with the land, previous to sowing.

The plant roots deeply and the ground requires a good digging at least 8 inches deep.

There are many cultivated varieties of *Ricinus communis* distinguished by various characteristics, such as the colouring of the stem which may be almost white, or of a glaucous bluish-green, or of a red colour with or without a white frost-like dusting on the stems and branches. There are also marked differences in the sizes and colours of the seeds, between one variety and another. Some, of a flattish shape, with dull-grey markings, $\frac{5}{8}$ inch in length were shown to the writer as coming from East Africa. Others, gathered from a tree growing wild in the Economic Gardens, not quite half an inch long, are oval in shape and rounded in contour: their colour is a bright reddish-brown with well marked yellowish veinings; while still others, also found growing wild locally, are just over $\frac{1}{4}$ inch in length, purple brown, with faint markings.

In Madras the seeds are classed under two main types:

1° The Coast and Warangal, which are small.

2° The Salems, which are large.

The Coast-seed of Cocanada is said to be the best for oil.

Some varieties are annual; others are grown as perennial crops. Mukerji mentions a small-seeded variety from the Deccan, which goes on bearing for 5 years in succession, and producing an oil of superior quality. (Handbook of Indian Agriculture).

The seeds of the small annual varieties are sown 3 feet apart, or better still, (if a subsidiary crop of ground-nut is interplant-

ed) at distances of two feet on rows four feet apart. Sowing one seed at each stake, three or four pounds of seeds would be sufficient for one acre; but it is as well to provide for failures by sowing two or three seeds four inches apart to each stake, and thinning out one month after germination, in which case seven pounds will suffice for one acre. This quantity will allow for selection of the best seeds, i.e. those showing the whitest and best developed "caruncle," or the fleshy out-growth near the hilum. The seeds in which, after steeping in water, this out-growth is found shrunken or discoloured, should be rejected.

Ricinus breeds true; cases of cross fertilisation being very rare.

The seeds of perennial varieties are usually sown at distances of 6 feet each way; but in the case of large, branching plants, wider spacing is perhaps advisable, as it is said that under a plentiful supply of air, the yield of seed is very largely increased, as much as 20 pounds of seed being recorded from vigorous plants under such conditions. Distances of 10 feet each way would probably meet the case, which would give 400 plants to the acre, necessitating less than two pounds of seeds. The writer has not had occasion, so far, to adopt such wide-planting, but the crops one occasionally sees on isolated trees, point to its reasonableness.

The Castor-seedling bears transplantation badly; the seeds are therefore always planted straight away in the fields. But the writer found that, from a cause not yet ascertained (probably the presence of eel-worm in the soil) a proportion of as much as ten per cent of his plants died in the second month. Such infected soils should not be planted with *Ricinus*; but should the discovery be made too late, it is advisable to have a number of seedlings apart in bamboo baskets to fill the vacancies after creosoting the earth at the spot.

As previously stated, the ground must be brought to a fine state of tilth by a preliminary digging to a depth of 8 to 10 inches, followed by a harrowing or raking. The longer the land is allowed to lie broken and exposed to the air before sowing the better; as it gives a chance to the sun and the birds combined, to destroy the maggots and grubs, which, later on, in the shape of caterpillars, will, if the land remains foul, almost surely attack the plants, and, possibly, cause extensive damage by stripping them of their leaves. The writer has seen a handsome tree, 12 feet high, completely defoliated in a few days by a small black and red striped caterpillar. When the tree was shaken, myriads of the caterpillars fell to the ground. The Castor-seed caterpillar, *Dichocrocis punctiferalis*, which bores its way into the seeds is also a dangerous pest.

Although Castor-seeds preserve their germinative power a very long time if protected from damage by insects, immersion in water for a few hours is not a useless precaution as it softens them and facilitates germination. A preliminary short steeping in an insecticide solution such as a weak solution of copper sulphate, just strong enough to give the water a faint bluish tint, or in a maceration of tuba root, may also do much good.

Fresh seeds of healthy plants, selected with due care, need no such treatment: they germinate very readily, provided the soil is kept moist by rain or, in case of dry weather, by one or two waterings after sowing.

On a plot sown with quite fresh seeds on the 30th March last, all the plants showed their seminal leaves on the 6th of April and on the 10th April, the second pair of leaves was already out.

After germination, no more watering need be given, except in the case of actual drought. No further care is required except weeding, and keeping a good look-out for caterpillars which, if they are not kept down by hand-picking or by insecticide sprayings (kerosine and soap emulsion) are likely, as already stated, to cause great damage to the leaves, and, in the case of *Dichocrocis punctiferalis* to the young flowering spikes.

The Castor-plant can be cultivated with advantage with other annual crops. Of all such crops, the writer would give the preference to ground-nut, *Arachis hypogaea*, which, besides being in itself a very profitable crop, has the advantage of supplying to the soil some of the nitrogen which the Castor-oil plant, an exhausting plant, takes out of it.

The perennial Castor-oil plant often grows to a height of 15 feet, but such a height is a very great drawback and adds largely to the cost of harvesting, which may last for two months, in weekly pickings, as the crop ripens intermittently.

To check the growth in height, the trees should be topped at an early stage so as to maintain them at a height of 6 to 7 feet. This moreover induces the formation of lateral branches which, later on, will throw out flowering spikes.

It is generally admitted that the Castor-oil plant exhausts the soil, that it should not be cultivated twice in succession on the same ground and that a period of at least two years should be allowed between two crops. When annual varieties of *Ricinus* are cultivated, it is therefore necessary to devise a scheme of rotation embracing a series of quick-growing field crops to tide over the interval between one crop of the Castor-plant and the next.

Such a scheme should include crops adapted to similar physical conditions of soil, but belonging to different natural orders, so as to check any undue increase of insect-pests or the spreading of fungoid diseases.

Ricinus, Ground-nut, Gingelly, Sweet-potatoes offer such a rotation, which, moreover, has the advantage that the deep digging necessitated by the harvesting operations in the two cases of ground-nut and sweet-potatoes, exerts a beneficial effect on the mechanical condition of the soil, to the advantage of the following crop of *Ricinus*.

An interplanted crop of groundnut has already been suggested above. In this country, it is a four months crop, which accommodates itself well to the quality of soil suitable for the Castor-oil plant, and which under fair average conditions, especially if the land

has been limed, would give from 2,000 to 2,500 pounds of pods per acre. This is equivalent, at the ratio of 65% of their weight, in Kernels, to 1,300—1,625 pounds of shelled Kernels with an oil-content, from an ordinary country-mill, of 30% to 40% or say 35%, i.e. a final output of 450 to 560 pounds of oil per acre. In addition there is the very valuable oil-cake which can be used either as cattle food, or as manure, as it contains as much as 8% of nitrogen.

Although it is generally poor husbandry to grow the same crop twice successively in the same ground, the practice can be, and is largely, followed in India without harm; in the case of groundnut, provided the land receives between the two crops, a moderate dressing of lime and ashes. It is therefore quite feasible to obtain two crops in the course of one year, resulting in an output of 2,600 to 3,250 pounds of Kernels per acre or 900 to 1,120 pounds of oil and from 1,200 to 1,450 lbs. of cake, dry.

Followed by Gingelly (*Sesamum indicum*) which does exceedingly well after groundnut, a further crop of oil-seed would be obtained which could be treated for oil by the same extracting appliances as used for Castor-seed.

A last crop of sweet-potatoes could be put in, as in digging up the roots, a thorough breaking up and pulverizing of the soil takes place, which will make easy the preparation of the land for a new crop of *Ricinus*.

Manuring will be necessary at this stage. Manures are scarce and expensive—but in this case, they will cost nothing more than the cost of application; for the stock of groundnut and sesamum-cake will amply suffice for the requirements of the land in nitrogen; the deficiencies in potash and phosphoric acid (of which groundnut cake contains 1.2%) being made up by an addition of ashes from the stems of the Castor-tree itself and other refuse (shells and husks) and, if necessary, a modicum of bone meal. Nor must we lose sight of the Castor-pomace saved from the original crop, which is one of the best vegetable manures known—Castor-cake containing $5\frac{1}{2}$ to 6% of nitrogen.

In February 1918 the price of the cake in London was £37 per ton, i.e. nearly 4 pence per pound. Considering that, by reason of its poisonous content, Castor-cake cannot be given to cattle for food, this price gives an idea of its high manurial value.

As a matter of fact, although the Castor-oil plant is considered to be an exhausting crop, it need not, under a careful system of husbandry, leave the land impoverished.

For taking the plant as it stands, all of the plant food which has gone to form the roots, stems, leaves and seeds with their capsules and husks, can be restored to the land in the form of ashes, or better still, after passing through a chaff cutter or a root-cutter, in the form of a compost, so that nothing, except the oil, need leave the farm.

Now, Castor-oil, like other stable oils, contains only such elements carbon, oxygen and hydrogen as are drawn from the air, and by the sale of it, the land loses none of its fertilising agents.

HARVESTING AND YIELD.

Having started planting in November, picking should begin about April for the earlier varieties and in May-June for the later ones. It is not a laborious operation and it can be done by women and children going over the fields once a week to pick the capsules when the calyces turn from green to brown and the yellow husks become visible. It may take over two months to finish the crop, but it often lasts less long if the weather, keeping hot and dry, hastens maturity. Harvesting is done by cutting the spikes, but where it is found that the capsules mature very unevenly on the spikes, a little hand picking of the capsules may be resorted to at first, to avoid loss of seeds, the spikes being cut later on when all the capsules present a more uniform degree of maturity. A less commendable method, but one which shortage of labour may excuse, is to let the capsules ripen and drop their seeds to the ground where they are gathered at leisure. This, of course, saves time, but it is admissible only where *Ricinus* is grown as a pure crop, and where the ground is clean and free from weeds. Where, *Ricinus* is grown with another oil-seed crop, especially groundnut the seed should be picked; the least admixture of Castor-seed with groundnuts would be fatal to the sale of the latter.

The capsules, collected in bags or baskets are brought to the store, and thrown in a heap on a clean concrete floor; a square enclosure is made to enclose the heap by putting up boards or iron sheets to a height of 3 feet—this to prevent the scattering of the seeds when the capsules open.

The heap which must be protected from the rain, is covered with gunny bags for 3 or 4 days and when, a beginning of fermentation having set in, the capsules have somewhat softened, the heap is opened, spread out and turned over in the sun. Most of the capsules will have shed their seeds in 5 to 6 days. Women are then put on to sort out by hand the broken pieces of shells which are taken to the compost heap or reserved for fuel. What capsules remain unopened are beaten with cudgels until all are disposed of. Small debris of shells remain mixed with the seeds after the bigger pieces have been removed, these are dealt with by means of the "*neeru*" a triangular tray, made of bamboo strips, with raised sides, or, if one is at hand, by passing the lot, seeds and debris, through a hand-winnowing machine.

The clean seeds, if they are to be made into oil on the farm, must be divested of their coats or husks. To this end, after two or three hours exposure to the sun to heat them, by which the husks are made more brittle, the seeds are passed between horizontal rolls set at a distance apart from each other, just sufficient to break the husks by slight pressure, without quashing the kernels. The husks being very brittle crack easily, and with a very simple contrivance, to lead the seeds on to the rollers, a mangle such as used for the sheeting of rubber would do very well for this purpose. The husks, though cracked, may still adhere to the kernels: a second passing between the rollers set a little closer will insure a further cracking,

and the seeds may then be put through the winnowing machine or shaken on the "*neeru*." Some of the Kernels may still have small pieces of husk adhering to them but this is of no consequence in the further process of expressing the oil. It may be here mentioned that the husks impart neither colour nor taste to the oil, so that the quality of the oil is not affected by their presence with the seed.

As a matter of fact, present up-to-date oil-mills equipped with powerful presses, treat seeds in the husk without taking the trouble of husking them: but with presses of small power, such as would be used on small plantations, the husks would retain an undue proportion of oil in the cake: for this reason seeds must be husked in the latter case.

On the other hand, if it does not colour the oil, the presence of the husks in the cake gives it a dark colour, and, moreover, it detracts from its manurial value, in that the husks contain no nitrogen; the nitrogen percentage of the cake is thereby lessened, and its value correspondingly lowered.

Hand power Castor-seed decorticators are also made by makers of Oil machinery by which the outer husk is removed and the white Kernel turned out ready for the press but present prices put them beyond the reach of the small farmer.

Under fair average conditions a crop of 800 to 1,200 pounds of seeds with their husks can be obtained off one acre in a season.

According to Spon's "Industrial Arts" 1,400 lbs. of Calcutta Seeds gave 980 lbs. of Kernels from which the following quantities of oil were obtained:

1st Quality	324 lbs.	} = 488 lbs. of oil.
2nd	" 87½ "	
3rd	" 76½ "	

That is to say that the Kernels divested of husks gave almost exactly half their weight of oil, *i.e.* 100 lb. of seeds gave 70 lb. of Kernels which in their turn gave of oil 35 lbs.
 " " of cake 35 lbs.
 the weight of the husks amounting to 30 lbs.

100 lbs.

These figures vary according to the amount of pressure used: a powerful set of presses may give from 5% to 10% more oil than weaker ones and correspondingly less weight of cake.

Again some varieties yield more oil than others and lastly some also show a greater weight of shell than others.

The writer found 268 seeds weigh 1½ ounce and after husking them found:

268 kernels	weigh	1 ounce
268 husks	" ½ "	"

These seeds were of a small variety in which the proportion of husk to kernel is likely to be higher than in the larger varieties.

The Bulletin of Imperial Institute 1911 gives a yield of oil of 55.41% of the weight of Kernels corresponding to 41.76% of the weight of the whole seeds containing:

kernels	..	..	75.37%
husks	..	..	24.63%

OIL EXTRACTION.

The extraction of oil consists of three operations, namely:

1st. The grinding of the seed to a fine pulp in order to break the oil cells.

2nd. The heating of the ground seed to facilitate the flow of oil.

3rd. The pressing of the pulp, to force out the oil, leaving the cake as residue.

A fourth operation consists in submitting the meal to the action of a chemical solvent in which the oil is dissolved and from which it is separated afterwards, the final residue or cake containing only a very small percentage of oil. This process which is only practicable in specially equipped mills does not concern the planter.

Large modern mills, as already stated, treat the Castor-seed whole, with the husks on; but a hand power plant such as would be called for, to deal with the small crops contemplated in this paper, could not supply the pressure necessary for an adequate expression of the oil from seeds in their husks.

The small planter will therefore have either to sell his seeds to the oil-pressers, or to treat the seeds after husking them more or less completely. We have shown above how this part of the work can be done.

The husked seeds have thus to undergo the three operations of Grinding, Heating and Pressing.

Some makers of oil-mill machinery are now supplying hand-mills to meet the requirements of producers who do not use power.

The Firm of Rose, Downs and Thompson, Ltd. of Hull and Shanghai, supply such a mill catalogued as "*The Manual Oil-mill No. 359*" to crush 56 pounds of oil-seeds per hour, and worked by two men.

"The Mill consists of the following machinery: one set of Anglo-American Rolls 3' high, 6 in. in diameter and 6 in. face, hand-driven with heavy fly-wheel; one wrought iron fire-heated pan or kettle, to be placed on a brick-foundation and worked by hand; one set of double hydraulic pumps, hand-driven, the large pump being arranged to give the first pressure rapidly, and the small pump to give the final or finishing pressure without a material increase of effort from the workman; one hydraulic press, to make five taper cakes 13" x 6" x 5" fitted with corrugated metal plates bearing any desired brand; one 4 in. hydraulic gauge and pipes; a supply of woollen press bags, mending yarn and other needful sundries."

But even such a simple plant may be, in these times of extravagant prices, above the means of the Planter, and in this case he will have to fall back on such makeshifts as he may find at hand.

With ingenuity and the gift of contrivance, he will find that his case is not hopeless.

Grinding of the Seed. The Kernels of the Castor-seed are soft and do not require the elaborate process of shredding or pulverizing, in disintegrators which Copra, for instance, requires. They can be ground, by passing between the rollers of a strong mangle such as used for sheeting rubber, or by pounding in a wooden mortar made *ad hoc*.

Heating of the ground Kernels. The pulp is conveyed to a platform heated by means of a flue underneath. The heat should not be greater than what the hand can bear, or say 140° to 150° F, and such a flue as used on coffee estates to dry parchment would be suitable. Or it may be simply a barbecue in the open, dependent on the heat of the sun, provided a movable roof shelters it from rain and a flue underneath allows, in cases of insufficient sunshine, to supply the heat necessary (140-150° F) to penetrate the mass of meal and render the oil more fluid.

Pressing. A hand-power screw press will fulfill this purpose. Such screw-presses are made by makers of oil machinery, which are furnished with several steel plates and capable of dealing with 8 to 10 pounds of seed per charge, the meal of crushed seeds being enclosed, after heating on the flue, in woollen or canvas bags and inserted between the plates. On pressure being applied, the expressed oil flows down to a tray at the foot of the press, whence through a spout it falls into a suitable receptacle.

So far, then, the series of manipulations are as follows:

1. The crushed meal of seeds, on issuing from the rollers of the mangle, is laid on the heated table.

2. When sufficiently heated, the meal is taken up with a small hand-shovel in quantities sufficient to fill a square or oblong mould made of four small scantlings 4 to 5 inches high, without a bottom, and of the same size (inside measurement) as the steel plates mentioned above. Strips of canvas bagging—cloths of suitable size are disposed on the top of the hot table and the mould placed in the centre of these cloths, is filled with heated meal: the sides of the cloths are then folded round the meal following the contour of the mould, which is taken off and the slabs of meal are now wrapped up in the cloths. They are left on the hot table until the number of slabs, 5 or 6, is sufficient to fill the press for one pressing: they are then inserted in the press between the plates which, in the meantime have been kept immersed in a bucket of boiling water.

The pressure is now applied and a whitish oily fluid oozes out which is collected below and boiled with its volume of water, while all impurities, as they rise to the surface, are skimmed off with a

skimmer made of gauze. The mucilage and starch, contained in the meal are taken up by the water and the albumin, coagulated by the heat, forms a film below the oil between the oil and the water.

The oil is removed to another pan and boiled again with half its volume of water, until water vapour ceases to rise, when a small quantity of the oil put in a cup is found to be perfectly clear, transparent and colourless.

By this second boiling in a fresh supply of water, the oil is clarified and freed of acid matters.

The boiling may be done in a "dapur" such as used by the Chinese for the cooking of gambir or of pig-food; a 2 feet diameter pan will do for the purpose: its edges are let into the brick-wall of the oven, and the walls are continued, forming like a well to a height of 2 feet, thus giving a capacity, if we take into account the concavity of the pan, of about $6\frac{1}{2}$ cubic feet or 40 gallons.

The boiling should be stopped as soon as the last drop of water has been expelled and no more bubbles appear.

Instead of a second boiling, the oil may be clarified by passing through charcoal in filtering bags, such as are used by distillers, or failing such, through a blanket.

The quantity of oil thus expressed would range from 30 to 35 per cent of the weight of the seeds with the husks on, leaving from 35 to 40 per cent of cake.

We may now bring our figures together and work out the produce of one acre of *Ricinus* interplanted with two successive crops of groundnut in one year.

An average crop of Castor-seed is computed to give from 800 to 1,200 pounds, or say, an average of 1,000 pounds of seeds which would result in 350 pounds of oil and 350 pounds of cake, yielding a gross revenue of:

$$\begin{array}{r} 350 \text{ lbs. of oil @ } 45 = 157.50 \\ 350 \text{ lbs. of cake @ } 5 = 17.50 \end{array} = \$175.00$$

The produce of two crops of groundnuts was given above as between 2,600 and 3,250 lbs. or say, 2,900 pounds of shelled Kernels, a readily marketable product at the present rate of \$25 per pikul; which will leave the planter a sufficient margin to cover not only all his costs of cultivation and of living but also the cost of manuring his fields for the following crop of his rotation, cost which need not be heavy for, it may be here noted, the leaves of *Arachis hypogaea* with the roots left after the nuts have been gathered, constitute, when dug under, a highly nitrogenous green-manure.

Given a land previously cleared, or under light blukar,—a land which could be made ready for cultivation at a cost say, of \$20 per acre, the cost of a first Castor-oil crop (not including buildings and general farm equipment, ploughs and harrows, spraying apparatus or oil pressing appliances) would amount to about \$100 per acre made up:—

by clearing, draining and cultivation	\$50
Seed, planting, weeding, harvesting, insecticides	30
Oil extraction and tins	20

The 2 intercrops of groundnuts would cost per acre:

100 lbs. of seed (two sowings) at 25 cents .. .	\$25
two sowings	10
two harvestings and 2 shellings	25
Bagging and transport to market	25

Groundnuts, Cost of two crops .. \$85

The total aggregate cost of one crop of Castor-oil and two crops of groundnuts would therefore be \$185.

The gross revenue of one acre of *Ricinus* has been already given as \$175.

From the figures obligingly supplied us by the Manager of the Singapore Oil Mills the present prices of groundnut for which there is an excellent market, stand as follows:

Grade 1 unshelled \$700 per koyan of 40 piculs.

" 2 " 650 " "

" 3 " 600 " "

Shelled nuts \$25 per picul.

Oil cake 8.50 to 9 per picul.

The aggregate of the two crops of groundnut *i.e.* 2,900 lbs. (= 2,170 catties) of shelled nuts at 25 cents per catty would bring a gross revenue of \$542.50

Making a total gross revenue of one acre (including the

Castor-oil revenue \$175) 717.50

Less expenditure 185.00

Leaving a nett profit per acre of \$532.50

If, however, making allowance for the vagaries of seasons, for undue prevalence of pests, and also for the fact that the groundnut, in this case is an interplanted crop,—not a pure crop—we cut down the returns from that source by one fourth and bring the amount of the two crops to 1,652.50 catties of shelled nuts, the revenue from groundnuts would fall to (1627.50 x 25) \$406.85 which added to the Castor-oil crop 175.00

would give a gross return of 581.85

and after deduction of all expenses 185.00

would leave a nett profit per acre of \$396.85

USES OF CASTOR-OIL.

The many uses to which castor-oil is put make it one of the most important raw materials of industry.

As is well known it is used in preference to other oils for dressing hides and skins, morocco leather, and generally all kinds of leather goods, belting, boots, harness, etc. as it makes leather soft and pliable.

It fulfills particularly well the functions of a first-class lubricant as being a heavy bodied oil and very viscous, it forms an effective film between moving parts of machinery and keeps them free from friction, and for that reason, it is used in preference to other oils, in concerns—estates and mines—where internal combustion engines are employed.

It is said that, mixed with a soda-lye, Castor-oil has the property of imparting transparency to the resulting soap and it is used for that purpose by soap-makers.

It enters into the composition of unguents and pomatums in perfumery in Europe as well as in India, where it is used as an ointment to keep the skin cool and open. In Italy, the well known "*Olio di Ricini a l'Inglese*" is, or was, in common use.

Among the less known uses to which Castor-oil is put is that of binding agent for certain insulating compounds which enter in the composition of "Enamel Wire" which is very largely employed for cables. The Western Electric Company of New York import for their own works alone 30,000 gallons of Castor-oil used, in great part, for that one purpose.

Castor-oil imparts fastness and lustre to the dyes used for cotton and woollen goods—and made under the name of Turkey-Red oil, after treatment in concentrated sulphuric acid. It is preferred by dyers as fixing agent for all alizarine colours.

Castor-oil is in great demand as lubricant for aeroplane-motors, owing to the fact that it is unaffected by a wide range of temperature.

Cases did occur during the war when, travelling at great altitudes, the oil congealed and failed to run into the bearings of the engine which would then get red hot, and fatal accidents were traced to this cause: but, it would appear from the "*Chemist and Druggist*" of 20th February, 1920, that means have since been found to prevent Castor-oil from congealing while retaining its lubricating properties.

From the same source, we also learn that casein combined with Castor-oil is now manufactured into flakes which mixed with water produce a perfect emulsion with the taste of milk.

The value of castor-cake as a fertiliser is very high, and a market exists for every pound of it produced.

Its medicinal properties are well known to all.

As a last resource, it can be used like other oil-seed cakes to generate gas for lighting or for driving machinery. This conversion of cake into gas is in practice in several towns of India, and Dudgeon gives us in '*Agricultural and Forest Products of West Africa*' an instance of Cotton-seed cake being put to the same use in an oil-mill at Ibadan (South Nigeria) where it was found that 6 hundredweight of such cake is sufficient to generate gas to drive a 30 h.p. engine for $9\frac{1}{2}$ hours.

Before closing this paper, the writer would emphasize the fact that Castor-oil is not a crop for extensive cultivation as a pure crop on a large scale. One of the reasons for this is that it produces normal crops only under such conditions as are quite congenial to it, and one such condition is *shade* during at least, one part of the day not overhead shade, but side shade from large trees growing to the East or the West of the field.

A planter of very long experience, in a letter to the writer, says: "Castor-oil is a peculiar plant. I reared it in Africa. "Grown wild, it yields well; cultivated in plantations, it hardly "yields at all; moreover the oil is of irregular and inconstant "density."

The same is to some extent observable in the Economic Gardens for the plants growing in the full sun—their growth is backward, their flowering is poor—whilst the trees which receive, either in the morning or in the afternoon, the shade from large neighbouring trees are showing quite good crops.

E. MATHIEU.

REFERENCES:

- Bulletin Imperial Institute 1911.
- Tropical Agriculturist August 1914.
- Mukerji, Handbook of Indian Agriculture.
- The Book of the Madras Exhibition 1915-1916.
- Laucks Commercial oils 1919.

Betel.

One of the first things noticed by the newcomer to the East is the red appearance of the lips and teeth of the natives together with their habit of chewing. He may also observe, particularly in country districts, that many of the natives carry a small tin or receptacle of some description about with them. A peep into this tin would bring to light various things but chief amongst them would be found some betel nut and betel leaves. These form the chief constituents of the mixture, known as "betel," which is chewed by many of the Eastern peoples. In towns the mixture may be seen ready made up for sale.

It is intended to give a brief outline of these two ingredients namely Betel Nut, the seeds of *Areca Catechu*, L., and Betel Leaf, the leaf of *Piper Bette*, L. The production of the former particularly, is essentially a native industry and is interesting on this account.



BETEL-NUT, ARECA CATECHU.

BETEL NUT.

ARECA CATECHU, L., the Betel Nut Palm (see accompanying plate).
General Description—

A palm which grows to a good height attaining in some cases 60 ft. Its stem is straight and cylindric, and ringed by the scars of fallen leaves. It is greyish in colour and is generally covered with lichens. The stem is very slender in comparison with its height but very strong nevertheless. The crown of leaves is rather small having a diameter of about 8 ft. The leaves are pinnate which places it in the feather-leaved section of Palms. They vary in length from 4 to 6 ft. and in the young state have a fairly straight leaf rhachis which forms an acute angle with the stem, but in older leaves the leaf-rhachis is curved. The colour of the foliage is yellowish green in plants grown in the sun and light green in plants growing in partial shade. The leaflets are more or less rigid giving the leaf a flat surface. Spathes are produced below the leaves and soon burst disclosing the much branched spadix which is pendulous and on the branches of which are produced the flowers. As the Palm is unisexual the female flowers are borne at the base of the branches while the male flowers are borne on spikes at the extremities of the branches and are arranged in two rows on the spike. In the plate facing p. 296 the two types of flowers can be easily distinguished the large unopened ones at the bases being the female and the tiny white crowded specks being the open male flowers. On the same plate will be seen a fine bunch of fruits which when they first appear are small and green. They very soon swell up and change colour becoming orange or orange scarlet when quite ripe and are from 1 to 2 inches in length when fully grown. The fruit consists of a fleshy pericarp surrounding the seed or betel nut. A fuller description of this palm will be found in the *Gardens' Bulletin* Vol. II, p. 252.

HISTORY.

Mention has been made of the "betel nut" for centuries, the earliest reference to it by a European being found in the writings of Marco Pole (1298 A.D.). Since that date the nut has been mentioned by many writers. Of its great antiquity there can be no doubt as mention of it has been found in manuscripts written in ancient Eastern languages. The nut has its place in the ceremonial and symbolic life of the people being offered as a polite indication of the termination of ceremonial visits. It is also symbolic of festivity and essential at the betrothal ceremony. It has held the same important position from earliest times.

HABITAT.

The exact locality in which this plant first grew is unknown as it has been found for centuries, cultivated over almost the whole of tropical Asia. It prefers a moist atmosphere as is shown in India where it is found growing only in localities which are notably

moister than other parts of that country. It does not grow at a very high elevation and is seldom found above 3000 ft. In Malaya it naturally thrives owing to the humidity of the atmosphere and is generally met with growing in compounds and occasionally in plantations. Almost every native compound in Malaya has its few "betel nut" palms which often serve a double purpose, to supply nuts and also to serve as a support for the "betel leaf."

PREPARATION OF NUTS.

Several varieties of the nut are met with in the market, the best class being those which have not undergone any preparation. These may be termed the natural or first class, and are simply dried in the sun before sending to the market. The artificial or second class includes all those varieties which have been prepared in some way before being placed on the market. The usual method of preparation is to boil the nuts either whole or cut into pieces. The latter operation is sometimes performed after boiling but not always. The value of the nuts largely depends on these factors and the natural class generally commands the highest prices in the market.

ARECA CATECHU OR KOSSA.

This is the only well known preparation extracted from the "betel nut." It is obtained in the following fashion. A quantity of scraped nuts are placed in water in a large copper pot; a handful of lime is added and the whole boiled for a time. The nuts are then removed and the same liquid is used for several subsequent boilings of nuts adding water when required. Eventually a thick red-brown substance is produced which is allowed to dry in the sun. This substance is Kossa and it is used to flavour and colour inferior nuts. So far as is known it has no particular value except for use in the above manner.

USES.

The chief uses of the "betel nut" are—

- (a) Masticatory.
- (b) Medicinal.

(a) Masticatory.—As previously indicated the chief use of the "betel nut" is for chewing purposes. It is sometimes chewed by itself but generally a small piece is rolled up in a "betel leaf" together with a little lime, catechu or kossa, cardamoms and cloves. Prepared in this way it may be seen in most native towns particularly in Indian Bazaars and shops. It is supposed to stimulate digestion and is also claimed to prevent dysentery and generally to strengthen the stomach.

(b) Medicinal.—The young nut possesses astringent properties and is used in the treatment of bowel complaints and ulcers. If used in powdered form it is very effective in the treatment of dogs for worms. The natives put it to many uses and with very good results.



FRUIT AND FLOWER OF BETEL-NUT TREE, ARECA CATPACH.

CULTIVATION.

Propagation is effected by means of seeds which are sown in a part of the plantation set aside as a nursery. Transplanting is carried out after about 2 years, the intervening time being used to prepare the ground and grow other crops. In this first transplanting the plants are placed 12 to 15 feet apart and are interplanted with shade plants, bananas often being used for this purpose. This set of plants fruit about the tenth or twelfth year. About this time the intervening shade plants are removed altogether and the second transplanting takes place, the plants of the first set now assuming the double role of production and shade. The second set do not fruit for about 20 years. There is no third transplanting except to fill in gaps caused by failures. It will thus be seen that the plants are eventually about 6 or 7 feet apart each way. Oftentimes other plants are used to fill in the gaps such as coconuts and fruit trees so that eventually the plantation takes on a rather jungle-like appearance. It may also be mentioned that some plantations are purposely planted up with plants other than the "betel nut." Very often too the "betel leaf" is interplanted with the palm and uses the palm stems as supports. The type of soil does not very much matter provided the atmospheric conditions are suitable and that plenty of manure is given to the plants. This latter has a considerable effect on the yield of nuts and in some places manuring takes place at least every two years. A moist soil is preferred though it is not essential so long as there is a good rainfall.

The most extensive cultivation is carried out in India where there are many plantations ranging in size from 1 acre to 100 acres. Methods of planting up vary considerably but all follow much the same lines. A certain amount of plantation work has been carried out in Malaya as will be gathered from statistics quoted later. Almost every native compound has its few palms to ensure a supply of nuts. Considerable quantities of nuts have been exported in past years but with the advent of rubber this industry has waned.

GENERAL REMARKS.

The length of time which expires before a plantation bears fruit is rather surprising as generally speaking it takes from 20 to 30 years to bring all the trees into bearing. The average fruiting life of a plant is from 30 to 60 years bringing its age up to 50 to 90 years and even more occasionally. This marks the close of its productiveness and though it will live on many years after it is unproductive and of no use to the grower. It will be seen that this palm is long-lived and this may have influenced its survival in cultivation for so many centuries.

The following extracts have been taken from the Blue Book of the Straits Settlements and prove fairly conclusively that the acreage in the S. S. under "betel nut" is considerably less than it used to be:

Year	Colony.	Acreage.	Price per pikul.
1910	Singapore	290 acres	\$3
	Penang N. E.	Mixed with fruit	\$3 to \$4
	„ S. W.	3000 acres	\$2.20 to \$4
	Prov. Wellesley	4997 „	\$2 to \$7
	Dindings	Mixed with fruit	\$2 50 to \$3.50
	Malacca	do	\$2.50 to \$4.00
1914	Singapore	In patches	\$4
	Penang N. E.	Mixed with fruit	\$3 to \$4.50
	„ S. W.	1400	\$3.50 to \$4.50
	Prov. Wellesley	3579	\$4 to \$6
	Dindings	Mixed with fruit	\$2 to \$3.50
	Malacca	do	\$2.50 to \$4.00
1918	Singapore	In patches	\$5
	Penang N. E.	Mixed with fruit	\$4 to \$6
	„ S. W.	1250	\$6 to \$12
	Prov. Wellesley	3102	\$6 to \$8
	Dindings	Mixed with fruit	\$3 to \$6
	Malacca	do about 141	\$7

Presuming the acreage under “betel” “mixed with fruit” remains the same as it was 10 years ago, though it is unlikely, there is a large decrease in acreage in the settlements where acreage is definitely stated. Summarising the above we get—

Acreage in 1910—8287 acres.

„ „ 1914—4979 „ decrease 3308 acres.

„ „ 1918—4352 „ „ 627 acres.

Giving a total decrease of 3935 acres in eight years.

A comparison of the prices shows an upward trend. The difference in price per pikul in eight years is very marked.

BETEL LEAF—(Piper Betle, L., see plate facing p. 298).

This plant is a pepper and belongs to the Natural Order *Piperaceae*.

General Description—

A perennial evergreen creeper or climber which grows to a considerable height given the necessary support. It has large heart-shaped leaves, which are thick and strongly 5 to 7-nerved. It produces spikes 4 to 6 inches in length of fleshy flowers which often cohere into a cylindrical mass.



BETEL LEAF PEPPER CULTIVATION, PIPER BETEL.

HISTORY.

The "betel leaf" plant is mentioned in very early European writings, also in the manuscripts of the ancients. As would be expected it is always mentioned in connection with "betel nut" and seems to have been cultivated for centuries for the purpose of chewing with the "nut."

HABITAT.

It is considered indigenous to Ceylon, India and Malaya and is cultivated throughout tropical Asia for its leaves. Java is suggested as its original home. Like its companion the "betel nut" it requires a humid atmosphere and grows extremely well where such conditions are prevalent.

USES.

Its recognised use is for chewing purposes and as an ingredient of "betel." The method of mixing it up with other materials has already been indicated. It is chewed in the green state and has a sharp pungent taste and is considered sustaining and particularly advantageous to a people whose food does not include flesh. Its tonic and carminative properties supplying the deficiency.

CULTIVATION.

Unlike its companion it requires considerable attention and the successful growing of it requires expert knowledge. As would be expected methods vary in different places both in propagation and general culture. The following broad principles may however be laid down for its successful culture.

Propagation is effected by means of cuttings and the method varies. The following two methods will suffice—

(1) Cuttings are taken from two year old plants and cut into lengths of 12 to 18 inches each with five or six joints; they are then planted burying two of the joints.

(2) Fully grown plants cut down close to the root, are stripped of their leaves and divided into three or four portions which are laid horizontally in trenches and covered with earth. They commence growth from each joint.

A fairly constant temperature is best, together with a uniform amount of moisture. The nursery should be if possible in a slightly elevated position to ensure good drainage. A good supply of water must be given as the plants need a moist soil. This latter should be rich in humus and manured at regular intervals. Top dressing is often resorted to, various kinds of manures being used. Shade must be given and for this purpose shade plants such as bananas or the "betel nut" palms must be utilised, otherwise artificial shade must be provided. It is a good plan to give the land a rest after a few years and then plant some other crop returning to "betel leaf" later.

In Malaya it is generally met with in "compounds" using as supports the stems of the palms, in other cases stakes are used, trellis work or anything which will allow them to climb. Attention is always paid to maintaining a sufficiency of shade overhead.

The cultivation of the two plants discussed above is essentially undertaken by natives and is without doubt a purely native industry. Unfortunately statistics are not available as to the export trade in "betel nut" but it is certain that with the large amount of native labour in the country and the decrease in acreage under "betel nut" the exports must be considerably less than in past years. There is no export trade carried on with "betel leaf."

F. FLIPPANCE.

Some Trials of Food Plants in the Economic Gardens III.

The Sword Bean.

(*Canavalia ensiformis*).

The Sword-beans seen in the accompanying plate were introduced into the Economic Gardens from Japan in February, 1919. Its cultivation has now been brought to the fifth generation and shows by its remarkably heavy crops its adaptability to our local conditions. A local sword-bean is frequently seen growing in Malaya, the difference between this and the Japanese being in the colour of the flowers, which is mauve in the Japanese plant, and white in the local one; and in the seeds, the local bean being bright ruby-red in colour, and the Japanese pale pink. A third white-seeded variety, the seeds of which were procured from Mr. W. Dunman of Grove Estate, is also grown in the Economic Gardens. It is a plant of very robust growth with large handsome mauve flowers and it fruits profusely: it is popularly known as "Owen's Bean" from the name of the popular Secretary of the S. C. C.

The plot, on which the plants were grown, is on the lower edge of a hillside, a piece of yellow stiffish clay, but self-draining by its position. It had been manured six months previously and had given a crop of Roselle. A liming, a good breaking-up with the changkol, and a finish-off with the rake made it a first-rate bed for the sword-bean, which thrives better in a fairly firm clay bottom than on a sandy one.

The seeds were planted three feet apart on rows 2 feet apart, being sown with the eye (hilum) down at a depth of 3 inches. Contiguous to this plot, another bed was planted with seeds of the local sword-beans.

In both cases, the growth was very rapid and 4 weeks after sowing a frame of supports had to be put up with transverse sticks overhead, to train the fast climbing vines, and support the mass of foliage.



Sword bean, *Canavalia ensiformis*.

The Japanese bean proved the earlier plant; it flowered and fruited two weeks before the local one did.

In about two and a half months from the time of sowing, the first picking of young hanging pods, when about 5 to 6 inches long, took place.

At that stage, they are tender, and can be eaten as a substitute for French beans, of which, however, they lack the flavour.

For that purpose, they should be sliced diagonally, boiled and then tossed for a few minutes in butter.

At a later period the pods become stringy, and later still they take a woody consistency, when they are useless.

The beans themselves are poisonous, unless they have been first divested of their skins, and the separated cotyledons have been heated over the fire previously to boiling them. But although the writer has eaten them after such treatment, the risk is too great to justify their use as a food, either for man or cattle.

The poisonous principle in the bean of *Canavalia ensiformis* is probably, judging by the odour of the freshly opened beans, the same as found by W. R. Dunlop (Tropical Agriculturist March 1916) in *Phaseolus lunatus*, viz: hydrocyanic or prussic acid.

The sword-bean is, as already stated, a very fast grower, which commends it as a restorative crop, in place of a bare fallow: to that end as soon as the first picking of the young pods has taken place, it can be dug into the soil, which it enriches with its stored nitrogen, while the copious leafage serves to aerate the soil and increase the supply of humus.

As a cover crop without staking, it has also much to recommend it, as its broad leaves spread rapidly over the ground and keep down the weeds very effectively.

If staked as previously described, it serves admirably as a screen for exotic plants which cannot be grown to their best under the sun in the open. Lettuces are amongst these. Under the strong sun the excessive evaporation saps the vigour of the plants—the leaves, instead of standing erect, close to the stem, droop away, while the stem itself bolts upward or trails limply on the ground. Strong rains on the other hand, often destroy the seedlings, or in the older stage, beat down the leaves and even tear them.

Under the diffuse light afforded by the foliage of the sword-bean (which has to be pruned when too thick) the excessive evaporation is reduced and the impact of the rain is broken. By using the sword-bean as a screen and rain-breaker, some quite fair samples (i.e. fair for our locality) can be grown even at sea-level.

E. MATHIEU.

Staking Yams.

The Chinese who grow yams in the Malay Peninsula do not trouble to stake them. This fails to obtain the best yield and should be remedied.

Yams upon light porous soils in areas where the rainfall is relatively small may be left to trail their vines on the soil, for thereby the moisture in it is retained: but nowhere in the Malay Peninsula is the rainfall small enough to justify this: on the other hand the great room afforded for development by the use of stakes produces a greatly increased return. Experiments, demonstrating this increase, were performed twelve years ago in the island of St. Lucia, West Indies (Agricultural Bulletin, Barbados, VIII, April 3rd, 1909, p. 105). The results were as follows:—

Race of Yam	Return when not Staked	Return when Staked
"Lisbon"	3.2 tons per acre.	6.7 tons per acre.
"Bottle-neck Lisbon"	2.4 tons per acre.	4.3 tons per acre.

Since the above was written the following note has appeared in the *Agricultural News*, March 6th, 1920.

"A note in the *Agricultural News* February 8th, 1919, drew attention to an experiment conducted at the Botanic Station, Montserrat, in yam cultivation, as to whether it was profitable or not to provide stakes for the vines to run on. Mr. Robson, the Curator, came to the conclusion that the increased yield produced by the staked plants would more than pay for the increased cost involved.

"Mr. Robson has recently forwarded a note upon a similar trial carried out in 1919 with the results obtained therefrom, six rows of six different varieties of yam were planted on ordinary banks, to which pen manure had been supplied, 4 feet apart, the plants being three feet apart in the row. These rows were staked, and five rows unstaked were planted alongside as a control. The yams were planted on May 1st, 1919, and reaped on January 19, 1920. The results showed that in every case there was a large increase in yield from the staked rows as compared with the unstaked ones, amounting to more than 100 per cent. on the total yield, thus confirming the results obtained in 1918."

I. H. BURKILL.

Some Factors in Plant Competition.

A preliminary account of the results of experiments conducted at the Rothamsted Experimental station to ascertain the relative importance of the different factors that come into play when one plant enters into competition with another is given in "*The Annals of Applied Biology*", Vol. VI, Nos. 2 and 3.

"Competition of one plant with another is a very complex, not a simple, phenomenon, and may be broadly analysed as follows:

- (1) Competition for food from the soil.
- (2) Competition for water.
- (3) Competition for light.
- (4) The possible harmful effect due to toxic excretions from the roots, if such occur.

"The first three factors lend themselves to direct experiment; the fourth is more difficult to demonstrate but the possibility of its existence must be reckoned with in estimating results."

A summary of the work which was carried out with mustard and barley provides the following:

"The mutual action of one plant on another when growing in juxtaposition, usually known as competition, is a very complex phenomenon.

"When the food supply is limited the dominant factor of competition is that of food and in particular the amount of available nitrogen. Other things being equal the total growth as measured by the dry matter produced is determined by the nitrogen supply, irrespective of the number of plants drawing on the resources.

"With limited food supply the efficiency index of dry weight production decreases with the number of plants as the working capacity of the plant is limited by the quantity of material available for building up the tissues.

"The decrease in light caused by overcrowding is a most potent factor in competition even when an abundance of food and water is presented to each individual plant."

T. F. C.

Effect of Lightning on Trees.

The question as to what extent groups of trees are effected by lightning and how far the damage extends after they have been struck is frequently discussed on estates where apprehension is often felt as to how wide a circle from the tree actually struck will be affected. The following extract taken from the Indian Forester Vol. XLVI, No. 3. contains interesting observations on this subject.

"Lightning-struck trees may be found surrounded by others which show no signs of having been struck at all, and trees standing only 4 ft. away from a tree may thus escape. On the other hand several trees standing close together are usually all more or less similarly affected. Of a number of records which I have of the maximum distance apart of any two trees struck in the same locality the four greatest distances are 50", 36", 35" and 33".

"Young chir advance growth and small woody shrubs have been found killed within a circle up to 18 feet radius round the base of a lightning-struck tree, but it is more frequent to find such shrubby growth apparently unaffected and I have no record of herbaceous growth showing any signs of damage at all. It is of course well known that the taller an object is the more likely it is to be struck, and it would therefore be unnatural to expect to find shrubby growth affected to the same extent as trees standing overhead.

"As a matter of fact I believe that only a very small percentage indeed of trees struck would die if other agencies did not combine to complete their destruction. Overmature tree with decreasing vitality might succumb but not healthy sound trees in full vigour. From general observations which are not, however, based on definite countings, I believe that under existing conditions about 50 per cent of trees struck (namely, so severely as to give clear

evidence) survive, and the death of the remaining 50 per cent is, I believe, mainly brought about by insect and perhaps also fungal attack.

"It will be seen that I should account for the subsequent death of lightning-struck trees in the main to insect and fungal attack following on local injury caused to the cambium and I can find nothing to confirm any theory which would attribute subsequent deaths to the belated but direct effects of the lightning."

T. F. C.

Castor Oil Plant Diseases.

The ever recurrent discussion as to the practicability of planting Castor Oil Plant as a first class crop in Malaya makes one keep a look out of enemies that the plant has encountered in other countries. The Tropical Agriculturist Vol. LIV, No. 3, contains the following quotation from the Journal of Mysore Agric. and Exp. Union Vol. I, No. 2,

"To the already considerable list of natural host plants of *Bacterium Solanacearum* (brown-rot of Solanaceae) must now be added the castor oil plant (*Ricinus communis*), which has been seriously attacked by the disease in various localities of Georgia and Florida,

"The *Ricinus* plants wilt in various stages of growth, and often at an early one. Dwarfing is usually the first sign of the disease in the seedling plants.

"Land on which any of the sommon Solanaceous plants have wilted should not be planted to *Ricinus*, unless it is known positively that the wilt was not of bacterial origin."

T. F. C.

Manuring of Rice.

The Agricultural Journal of Egypt, Vol. IX, contains an interesting note on the effect of nitrate of soda as a fertiliser for rice. Four plots manured with 85 kilos of nitrate of soda gave a return of 15010 rotls as compared with 12693 rotls from four untreated control plots.

T. F. C.

Vegetable Oil and Palm Products Industry.

The following notice appearing in Tropical Life March, 1920, may prove of interest to those contemplating planting the Oil Palm in Malaya.

It has been proposed that an Association be formed to advance and safeguard the Vegetable Oil Palm Products Industry.

"It is not to be carried on for the purposes of trade, but to safeguard and advance the interests of the trade generally in such manner as the members of the association shall think best. No details have been gone into at present, and whether the official headquarters will be in London, elsewhere in the U. K., or at some centre abroad has yet to be decided. We should, however, be glad to have our readers' opinion on this point. In any case London would be headquarters for the receipt, collection, and distribution of news, likely to be of interest to members who would, as time went on, decide what the nature of that news would be. It is suggested that at first the subscription be \$10 American gold, or its equivalent in other currencies.

"The publishers and proprietors of *Tropical Life* are willing to include a supplement, especially devoted to the interests of the International Association, as and when desired, whether monthly or otherwise, and then, on terms to be agreed, copies will be sent to all members.

"We hope to hear from those, interested in vegetable oils, palm products, etc., whether the idea appeals to them and if so shall be glad if they will state in writing their willingness to become members and help the Association to be a benefit to the vegetable oil world generally, whether as producers, transporters manufacturers, distributors or consumers."

T. F. C.

Fruit Cultivation.

The steadily rising prices in the cost of locally grown fruit seem to be due not only to a demand from an ever increasing population but also to the common destruction of orchards either for substitution of rubber as a better paying crop, or where the orchards have been planted around towns, to make way for the still more pressing demand of land for building. These factors are contributing largely and rapidly to a shortage of locally grown fruits and high prices, and many are consequently turning their minds to plant sufficient fruit trees to provide a supply of fruit for themselves and their labour force. To those contemplating planting Citrus fruits two articles that have lately appeared should prove of interest. "The Possibilities of Citrus Culture in South India," in the *Tropical Agriculturist*, February 1920, considers the type of soil and the best varieties to plant. "Notes on Citrus Culture," in the *Queensland Agricultural Journal*, February 1920, treats of the management and working of Citrus orchards. Both articles are well worth perusing.

T. F. C.

Cola nitida at Singapore.

In the Gardens' Bulletin, Vol. II, No. 3, some data regarding the yield of trees of *Cola nitida* cultivated in the Economic Gardens, Singapore, were given. Mr. Mathieu recently had some of the trees manured, and one fruit just matured weighs 1 lb. and contains six fully developed seeds, it measures 6 in. in length and $10\frac{1}{2}$ in. in circumference. This is a considerable advance on those hitherto recorded, and is to be attributed to the effects of manuring.

T. F. C.

Botanic Gardens.

The following extract from the "Agricultural News" February 7th, 1920, is reprinted from the Trinidad Guardian 1919, on the occasion of the centenary of the Royal Botanic Gardens, Trinidad, "The Trinidad Royal Botanic Gardens at St. Ann's Port-of-Spain have this year entered upon the second century of unbroken existence. There are very few Botanic Gardens in the British Dominions over seas which can boast of so long a life. Some were founded before these, it is true, but for one reason or another they were abandoned or allowed to fall into decay, to be revived in some cases at a later date when their value was once more appreciated. The Garden of St. Vincent is a noteworthy example, because it was the first of the British tropical gardens, and was drawn upon to start the Trinidad Garden. It was abandoned after some sixty years of activity, and was re-established after a resting period of about another sixty years. Jamaica founded the Bath Garden in 1774 eight years after the St. Vincent one: this was also subsequently abandoned, and restored to some extent. In the East the Garden at Penang in the Straits Settlements was started in 1800; but had a chequered history, being abandoned and restored more than once. The present Singapore Garden dates from 1878.

"Two Gardens which have already reached 100 years are Calcutta, founded in 1786, and Sydney, New South Wales, 1816. Peradeniya, Ceylon, the successor of earlier gardens in the low country will reach its century in 1921. Botanic Gardens are, however, not comparatively new developments. In Europe the old monastic institutions maintained gardens to provide pulses, vegetables, fruits, etc., and also medicinal plants.

"The Royal Botanic Gardens of Kew, to which the Colonies owe so much not only for the plants but also for the trained men it has distributed, arose as a Physic Garden. Fostered by George III and Sir Joseph Banks, Kew rapidly grew in importance as a centre of botanical activity."

The date 1878 given for our own Gardens at Singapore is the date the management was taken over by the Government. The original part of the present Gardens, the Bandstand Hill, was laid out under the Singapore Agri-Horticultural Society in 1862, the site having been acquired in 1859 when the Society was formed.

Previous to this a Botanic Garden had existed near Fort Canning, having been founded by Sir Stamford Raffles in 1822, but it was abandoned in 1829.

T. F. C.

Chrysil Rubber.

To the rubber-producing country of Malay the article appearing in the India Rubber World of January 1st, 1920 under such a title as "Three Hundred Million Pounds of Chrysil Rubber" may well draw attention. An ecological survey of the flora of Western North America provided 25 species of plants containing latex. In four of these the percentage of rubber was high enough to warrant the hope that the species may serve for the production of rubber on a commercial scale. Twenty five pounds of the product of *Chrysothamnus nauseosus*, termed Chrysil rubber, submitted for examination was stated to be "high grade and average quality, not as good as the best fine Para, but a great deal better than most Africans or low grade rubbers." The best samples carried only three per cent of rubber and most of them ran less than two per cent. The article continues, "It should be noted by the way that the *Chrysothamnus* is not a latex producing plant. The rubber is found in the individual cells of the shrub, as in guayule. Like guayule also it is found principally in the parenchymatous elements of the cortex. It may also be noted that rubber does not appear to be laid down during the first year of growth of a tissue, and, indeed, unless present in large amount, is not readily detected by the histological method in portions of the plant less than three or four years old.

" Shrubs of interest as possible rubber producers are usually of good size, measuring three to eight feet high and about as broad. The rubber is present for the most part in the inner bark of the stems, and those portions in average mature plants will weigh from five to fifteen pounds. An exceptionally large plant found near Lone Pine, California, weighed 60 pounds exclusive of the twigs, and shrubs weighing 20 to 40 pounds are not rare. This is partly because the plants reach the maximum size only under favorable conditions and partly because they are frequently burned or cut off near the base after which new stems shoot up only to be again destroyed before reaching maturity.

" Another shrub that is treated at length is the *Haplopappus*, which contains considerably more rubber than the *Chrysothamnus*, from 6 to 10 per cent. The product is, however, soft and resinous."

An extract is given showing that it is computed bushes that exist to give a yield of three million pounds of rubber.

T. F. C.

Vitamines.

In the planting of food crops and the preparation of a diet for the labour staff it is impressed on one that it is essential food containing vitamins be allowed. This is a comparatively new term in modern parlance and the following extracts may be of assistance to those concerned with these questions. The Chemist and Druggist February 14th 1920 in the course of an article states, "As is well known, the knowledge of the presence and importance of vitamins is comparatively new, and as yet nothing is known as to the chemical nature of vitamins. But of their importance in nutrition there is no doubt, although, strictly speaking, they are not nutritive in the same sense as proteins, fats, and carbohydrates. It has been established that the dietetic deficiencies which are the cause of beri-beri, scurvy, rickets, and pellagra are due to the absence or want of balance in the proportions of vitamins that should form part of the normal diet. The report deals with a large number of experiments that have been made of feeding animals on artificial diets with and without vitamins.

"The primary sources, however, are the green leaves of plants and the embryos of certain seeds."

The following is taken from Agricultural News, Feb. 21, 1920.

"In an interesting note in the Descriptive Catalogue of the British Scientific Products Exhibition, 1919, several important results of the (Lister) Institute's work are described.

"One of these is the manner in which scurvy was exterminated among the Indian troops in Mesopotamia during the war. At the beginning of the war those troops suffered very severely from scurvy. This disease is caused by the want in food of certain substances called vitamins. Vitamins occur only in the minutest quantities, but if they are wanting in human food a variety of diseases, according to which of the vitamins is deficient, result, with probably consequent death.

"In Mesopotamia, on account of the difficulty of transport, the Indian troops were at first fed principally on dried grains and pulses—good and concentrated foodstuffs, but wanting in one of the essential vitamins. The result was an epidemic of scurvy,

"The Government appealed to the Lister Institute for help, and this was at once forthcoming, as the discovery had been made by researches in the Institute that if a dry pea is allowed to germinate, large quantities of antiscorbutic vitamins are at once formed. All that was wanted was to damp the peas, and expose them to the warm Mesopotamia air for a few hours when they sprouted, and formed the necessary vitamins. This sprouting did not interfere in any way with the cooking of the peas, and, yet, when treated in this simple way, they became a perfectly wholesome food, and the scurvy disappeared."

T. F. C.

The Discovery of Rubber.

The history of the introduction of the potato and tobacco to Europe is known to every school boy but how many of the thousands interested in rubber know anything of its origin? The following extracts taken from the *India Rubber World*, March 1st, 1920, should prove very interesting to Malaya. "How India Rubber was made known to Europe by Charles Marie de La Condamine, of the Academy of Sciences, and later of the French Academy is told very entertainingly by André Dubosc in his "*Histoire du Caoutchouc*." La Condamine separated from a scientific expedition with which he was travelling to Ecuador and Peru, and made his way alone across the Andes to Quito. "He was a good botanist and he kept his eyes open, and on reaching Quito the first thing he did was to send to the Academy of Sciences "some rolls of a blackish, resinous material" which he had gathered in the forests, namely, caoutchouc. This was in 1736."....."La Condamine in writing home explained that this liquid flowed out of a tree, *Hevé*, after a single incision, milk-white and gradually hardening and blackening in the air. The natives made torches of it; they spread the liquid on cloth and used it as we use waxed cloth. Along the Amazon the Indians made boots of it which kept out the water; they put it around moulds shaped like bottles, and when the gum had hardened they broke the mold, producing a light, unbreakable bottle that would hold any liquid. He set to work himself and made waterproof cloths, and also a splendid rubber case for his quadrant. He noted too, that the natives made small bottles of the rubber which they filled with hot water and used as syringes; they in consequence, called the tree, *seringueira*.

"By September, 1742, after he had made important discoveries in physics and mathematics, he decided that his work was done and that he would make his way down the Amazon to the French settlement at Cayenne, a journey of 2,000 miles in nearly unexplored regions. He made the journey alone, with only native attendants and reached Guiana in May, 1743. On his trip he had plenty of opportunities of examining the manner in which the rubber grew and the natives utilized the rubber. As France was at war with England he was obliged to wait two years at Cayenne before returning home, but he reached La Rochelle at last on March 7, 1745. He returned to his literary pursuits and told in the salons the story of his adventures and the wonderful qualities of the rubber which he had found, specimens of which he exhibited. Paris of the eighteenth century, however, did not take the discovery any more seriously than it did the beginnings of modern science, and it was reserved to Hancock and Goodyear in the following century to break the way for the modern uses of rubber.

"In the five years following his return La Condamine wrote six big volumes, and, despite his social activities and his literary quarrels, kept up his interest in rubber. His friend Fresneau found the rubber tree in Guiana and wrote to him the description of the native method of gathering it, smoking it and using it. He and

the French chemists who examined the new substance reached conclusions that are startlingly similar in many points to those reached by modern rubber chemists. Fresneau, for instance, thought it was a kind of condensed resinous oil; the name now used is polyterpene. To prevent it from sticking he used Spanish white, ashes or dust.

"La Condamine induced other explorers to search for rubber and learned before he died in 1775 that it had been found in the Isle de France and in Madagascar. Nevertheless, the only practical commercial use found for the caoutchouc in that century was as an eraser of pencil marks, which led to Priestley's christening it by the name it has retained in English, "india rubber"."

T. F. C.

How to Destroy Large Jungle Trees.

In clearing the jungle from an estate it is often a great source of trouble and expense to get rid of the large jungle trees. Too often does one see their stumps and roots remaining, a ready centre of fungus infection to the rubber trees just when they are beginning to bear at their best. The following note taken from the Indian Forester, May, 1920, may be of assistance to those about to clear jungle. Of course this method can only be employed whilst the tree is yet living.

"Where it is desired to destroy a tree without cutting it down, a hole is bored in the tree in a downward direction to the centre. For large trees an inch auger is used; for smaller ones $\frac{1}{2}$ inch size is large enough. For large trees 1 oz. to 2 oz. of ordinary commercial saltpetre (nitrate of potash) is used, and for smaller ones $\frac{1}{2}$ oz. to 1 oz. A plug is put into the hole to keep the rain from washing it out. The nitrate of potash is carried by the sap to the tips of the branches and the rootlets. If the tree is a large one, say, 2 feet or more in diameter, very little difference will be noticed in the foliage for 2 or 3 months, then the leaves begin to fall, and it assumes a bare wintry appearance. At the end of about 6 or 8 months a little brushwood is piled around the tree and lit; it will smoulder away to the remote ends of the roots, sometimes 30 feet away from the tree, leaving masses of valuable ash; the tree will fall, and when fallen it will continue to smoulder until every particle is converted into ash.—["A Hand-book of Forestry" by A. D. Webster.] "

T. F. C.

DEPARTMENTAL NOTICES.

A list of plants which can be purchased at the Botanic Gardens, in Singapore and in Penang, can be had upon application. The same list appears at intervals in the Government Gazette.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for every volume of twelve numbers, post free:—

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.

Reproduction from it is not prohibited.